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[ILLUSTRATED.]

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Christie Patent Telescope Pulley.

Among the many interesting things shown at the National Electric Light Convention, last week, which tend to make electric lighting as efficient and practicable as possible, Mr. Geo. H. Rose, of San Francisco, showed the Christie telescope pulley, which is especially adapted for driving from high speed. For a long time it has been the aim of many inventors to run belt pulleys at a high velocity, conveying a large amount of power direct from the main shaft with the provision of readily releasing it, relieving the belt entirely of duty, so that there are no moving parts, su h as loose pulleys, etc., but in no instance have they met with thorough success.

Mr. Christie claims to have met all the requirements in designing his telescope pulley, illustrations of which are shown herewith. It has been fully experimented with, and is now an established success.

The perspective view shows the apparatus, with the belt hanging loose on station ary belt-holder, the pulley being unshipped from under the belt, and revolving with the shafts. The hand-wheel, with spindle and worm, the worm segment and clutch levers are shown in such a manner as to require no explanation. The belt guide, secured to top of stationary holder, is also fully shown in the engraving, and needs no explanation.

Fig. No. 1 represents the stationary belt-holder with belt resting on it, the pulley being unshipped.

Fig. No. 2 represents the pulley in place when doing duty.

To explain the operation of the device, the sectional views are numbered, and the same letters apply in both.

A is the driving shaft, *B* is the driving pulley, *C* is the stationary belt-holder, *D* is the clutch lever, *E* is the worm segment, *F* is the worm.

When in duty, the pulley is one-fourth of an inch clear of the belt-holder. When not in duty, the position of all parts are as shown in Fig. No. 1. To engage the pulley, it is made to telescope over the drum of station ary holder and under the belt, gradually starting it into motion, so that by the time the pulley is in place the belt is in full mo tion. This is accomplished by means of the hand-wheel and spindle carrying the worm *F*, moving in worm-wheel *E*, operating clutch *D*, so as to slide the pulley laterally on the shaft and feathers in the same manner as an ordinary clutch.

The edge of the pulley is tapered, so that when it reaches the edge of the belt the latter at once rides on it, in the same manner as a belt does on a crowning pulley, and the transfer from the stationary holder becomes easy.

Under ordinary circumstances, the belt is shipped on to a pulley, but in this case the pulley is shipped under the belt. The belt guide shown in the perspective view prevents any lateral motion of the belt. To disengage the pulley, it is moved out from under the belt, in the same manner as when entering, by moving the hand-wheel and worm in the opposite direction.

The stationary belt-holder may be secured to the floor or ceiling, or otherwise, as may be convenient. The whole thing is simple, strong, and not liable to get out of order, the only moving part, when doing duty, being the pulley itself, all the other parts being at rest and doing no service.

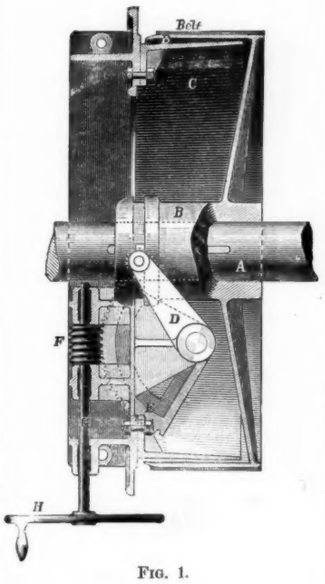
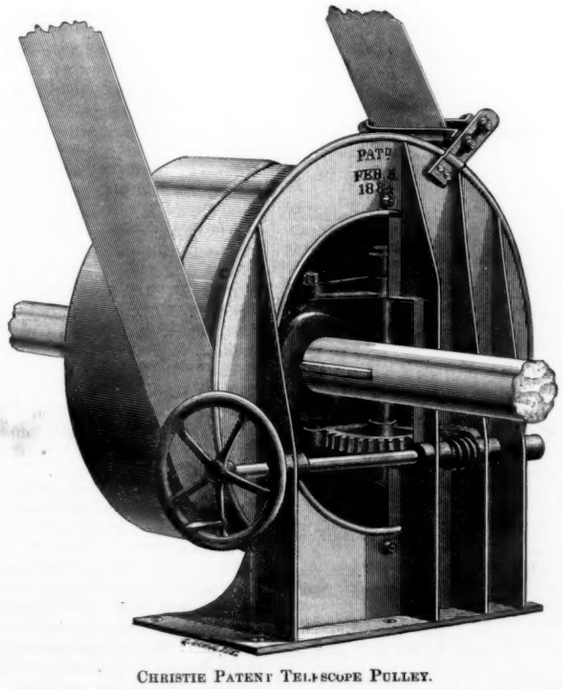


FIG. 1.

To electric lighting companies and others driving from high speed, this invention is of importance.



CHRISTIE PATENT TELESCOPE PULLEY.

*** Some enterprising people in Belgium have applied the telephone to a novel use. Little bells are supplied and fitted to the beds of all who desire to rise early in the morning but cannot do so of their own accord. A certain time is fixed and communicated to the central station, and, at the precise moment agreed upon, the current is turned on, and the bells commence to ring, and continue doing so until the slumberer awakes, leaves his couch and informs the head office that he has had enough.

*** A bill in equity has been filed in the District Supreme Court by C. G. Beryman for Henry C. Strong, of Chicago, against Robert B. Vance, Acting Commissioner of Patents, and Elisha Gray, for an injunction to restrain the issuing of a patent to the latter. The complainant states that he is the inventor of the railway electric telegraph and telephone, and made application for a patent May 18, 1877; that this application has been kept alive by amendment to claims, etc.; that Gray subsequently filed an application for a patent for a "multiple telegraph," which, he alleges, was by trickery and deceit, stolen from him, and is nothing but a reproduction in principle and design of his machine and invention. He charges, on information and belief, that by undue influence and by complicity with the examiners, Gray is about to receive a patent therefor; that the issuing of a patent to complainant is delayed by the undue influence exerted by Gray, and the patent to Gray is about to be issued by fraud and collusion with officers of the Patent Office, and if so issued will greatly injure and delay him, and necessitate long and tedious litigation on his part. He further alleges that he is entitled to have official action taken on his claim, and asks an injunction and relief. Judge Hagner set the first Monday in September at 12 o'clock for a hearing.

Annual Meeting of the National Telephone Association at St. Louis.

GOOD ATTENDANCE AND GREAT INTEREST TAKEN IN VALUABLE PAPERS READ.

The National Telephone Exchange Association convened in the very comfortable large parlor of the Southern Hotel at 11 A.M., Tuesday, September 7, President C. N. Fay in the chair.

Vice-President Durant stated, in behalf of the Bell Telephone Company, that a river excursion would be tendered the members for Wednesday afternoon. The invitation was, on motion, accepted.

The secretary then called the roll, and the following "active members" answered to their names.

American Telephone and Telegraph Co., E. J. Hall, Jr., general manager.

Bell Telephone Co., of Buffalo, E. J. Hall, vice-president; H. C. Palmer, secretary and treasurer.

Bell Telephone Co., of Missouri, Geo. F. Durant, general manager; E. A. Hitchcock.

Central District and Printing Telegraph Co., Pittsburgh, H. C. Metzger, general manager; M. R. Wolff, superintendent.

Colorado Telephone Co., E. B. Field, general manager.

Central Pennsylvania Telephone and Supply Co., Williamsport, Pa., R. M. Bailey, general manager.

Chicago Telephone Co., Chicago, C. N. Fay, general manager.

Central New York Telephone and Telegraph Co., Utica, N. Y., H. L. Storke, president.

East Tennessee Telephone Co., New York City, D. I. Carson, general manager.

Empire State Telephone and Telegraph Co., Auburn, N. Y., H. L. Storke, president.

Erie Telephone and Telegraph Co., Boston, Jas. W. Bennett, president; C. J. Glidden, treasurer; J. P. McKinstry, general manager; J. K. Dunbar, superintendent Southwestern Division.

Hudson River Telephone Co., New York City, H. L. Storke, president; A. B. Uline, general manager.

Metropolitan Telephone and Telegraph Co., New York City, J. A. Seeley, electrician.

Missouri and Kansas Telephone Co., Kansas City, Mo., J. R. Mulvane, president; C. D. Crandall, secretary and treasurer; W. W. Smith, general superintendent; C. McDaniels, superintendent.

Nebraska Telephone Co., Omaha, Flemon Drake, general manager; J. J. Dickey, vice-president.

New York and New Jersey Telephone Co., Brooklyn, W. D. Sargent, general manager.

New York and Pennsylvania Telephone Co., New York City, W. N. Easterbrook, general manager.

New England Telephone Co., Boston, J. N. Keller, general manager.

Ohio Valley Telephone Co., Louisville, Capt. H N. Gifford, general manager.

Penn Telephone Co., Harrisburg, J. B. Kerr, general manager.

Southern Bell Telephone and Telegraph

Co., New York City, D. I. Carson, general superintendent.

Rocky Mountain Bell Telephone Co. (new member), Salt Lake City, C. F. Annett, president.

Southern New England Telephone Co., New Haven, Conn., H. P. Frost, general manager.

HONORARY MEMBERS.

American Bell Telephone Co., Boston, Mass., C. Jay French, assistant general manager; T. B. Doolittle, F. B. Knight, R. S. Boyd, J. M. Brown, A. O. Morgan, T. D. Lockwood.

Bell Telephone Co. of Canada, Montreal, Charles F. Size, vice-president; Charles P. Sclater, secretary and treasurer.

Bridgeport Brass Co., Bridgeport, Conn., H. D. Stanley,

Beetle, Col. George L., New York City.

Childs, Wm A., New York City.

Cheever, C. A., New York City, by Geo. T. Manson.

Day, A. G., New York City, by Clark B. Hotchkiss.

Lockwood, T. D., Boston. Mass.

Standard Electrical Works, Cincinnati, E. V. Cherry, vice-president; H. T. Crane.

Western Electric Co., New York and Chicago, J. M. Jackson, C. A. Brown, F. W. Harrington, and J. W. R. Patterson.

The President, Mr. Fay, then delivered his annual address, which was attentively listened to and applauded at its close. He congratulated the members on their presence and on the bright prospects for the telephony of the future. The belief in the great profits of the telephone business, he said, was a popular fallacy. He could see no millionaires among their number. The number of telephones now in use was about one-fourth of 1 per cent. of the entire population of the country, and they could not hope to reach more than one half of 1 per cent. of the population. It was only the business man, the capitalist who used the telephone. The workingmen, the laborers, had no use for them. The business was restricted to certain limits, which could probably never be overreached. The city companies had had to face enormous expenses for underground lines; the companies doing country business had been compelled to carry out still further the process of closing and abandoning exchanges which had proved too small for self-support City and country exchanges alike had suffered from legislative and municipal attacks upon their rates, and the whole business has been disturbed and unsettled by the Government attacks on the Bell patents. He then proceeded to discuss at length the justice of the various attacks made on the Bell company and the various license companies. The stock of the American Bell Telephone Company, said Mr. Fay, is $10,000,000, now selling in the market for $19,000,000. Of this amount the shareholders actually paid into the company's treasury in cash $6,000,000, showing their profit to date to be $13,000,000. The licensee companies throughout the country are capitalized at about $54,000,000, selling in the market to-day for only about $25,000,000, an amount considerably below the actual money paid therefor, and below the actual cost of the plant and acquired business. There were undoubtedly individuals, the speaker admitted, who, in the manipulation of telephone stocks, had made considerable fortunes; but the broad fact remains that $15,000,000 would cover the entire amount of profit which the telephone fraternity have been enabled to exact from the suffering people during ten years of hard work, and add to their investment of $30,000,000 of capital say 5 per cent. per annum. On the basis of the last census this would be 3 per cent. per annum extorted from each one of the suffering people. A comprehensive review of the telephone litigation, with caustic allusions to the action of the U. S. administration, concluded this very able address.

Secretary Barney submitted his annual report. The year, he stated, closed with 34 active members and 33 honorary members. The work of the office established in New York was reviewed and the method of furnishing information to members explained at detail. The secretary presented the treasurer's report as follows:

Receipts, $2,312.05; disbursements, $2,311.15. Portion of expenses were for unpaid bills left over from the previous year; the actual expenses for year just closed being $1,997.93. A portion of the receipts were in like manner for uncollected dues, the actual income for past year being $.1,887.05. On basis of present membership, with dues at $50, the income next year will be $1,700. Cash in hands, $133.35. The secretary stated that the association had no liabilities whatever.

The secretary announced that the meetings of the convention would be held from 10 A.M. to 1 P.M., and from 3 P.M. to 5 P.M.

The election of officers for the ensuing year resulted as follows:

President—C. N. Fay, Chicago.

Vice-President—H. C. Metzger, Pittsburgh.

Secretary—C. H. Barney, New York City.

Treasurer—H. L. Storke, New York City.

Advisory Committee—Capt H. N. Gifford, of Louisville, for three years, in place of Mr. Sunny. The committee now consists of Messrs. Gifford, Jackson and Tyler.

Executive Committee—Messrs. Sargent, Keller, Stone, Bailey.

The city of Pittsburgh was selected as the place of holding the next annual meeting, the date to be selected by the Executive Committee.

The proposed changes in the constitution—laid over from the last meeting—were discussed, and adopted as follows, the changes being in italics:

"Article XIV. Section 1. The admission fee shall in all cases be ten dollars, to be paid on signing the constitution. The annual dues shall be *fifty* dollars for each vote now had or that may be hereafter acquired under the constitution, and shall be payable yearly, on or before the first day of July in each year." (Proposed by the Executive Committee.)

"Article IV. Section 1. The officers of this association shall be a president, vice-president, secretary, treasurer and an executive and advisory committee, who shall, with the exception of *the secretary and* the members of the advisory committee, be elected at each annual meeting of this association, and shall hold office for one year, or until their successors are duly elected and qualified. *The secretary shall be appointed, for the ensuing year, by the newly-elected Executive Committee.*" (Proposed by the Executive Committee.)

"Article XVII. Section 1. *Any person nominated by the Executive Committee may become an honorary member of this association by a vote of two-thirds of all the members present at any regular meeting, such election to be by ballot.*" (Proposed by Mr. E. J. Hall, Jr.)

The following additional article provoked considerable discussion:

"Article XVIII. (Additional Article.) Section 1. *Any person or corporation actively interested in the objects of this association may become an associate member of the association by a vote of a majority of the members present at any regular meeting.*

Section 2. *An associate member shall have no vote in the meetings of the association, but shall be entitled to all the other privileges of regular members, and shall be subject to the same dues and assessments.*" (Proposed by Mr. E. J. Hall, Jr.)

Mr. Metzger moved to strike out the second section, and spoke in favor of his motion; Messrs. Sargent, Seely and others opposed this motion. The motion was lost.

On motion of Mr. Easterbrook, Section 2 was amended by adding the words "except during executive session" after the word "members."

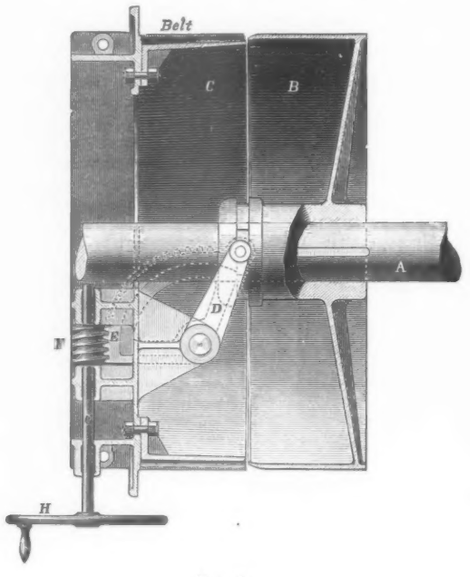


FIG. 2.

The following change in the by-laws was proposed at the last meeting by Mr. H. L. Storke, and came up for action. It is an additional section to Article III, and was adopted.

"Section 5. *The secretary shall, under the direction of the Executive Committee, procure and compile for the use of the association such statistics relating to the telephone business as have heretofore been furnished by the various committees of this association.*"

Mr. Carson suggested that each member of the association make a contribution of $10 each to be sent to Charleston, S. C., in aid of the earthquake sufferers.

Mr. Durant favored making the donation the official act of the association.

Mr. Drake and Mr. Kerr thought it should be an individual contribution, the former stating that his company had contributed at Omaha.

On motion of Mr. Easterbrook, a committee of three was appointed to solicit individual donations. Messrs. Easterbrook, Carson and Durant were appointed.

The following members had contributed the amount of $10 each up to the close of the meeting. H. R. Frost, C. N. Fay, D. J. Carson, E. V. Cherry, ELECTRICAL REVIEW; H. C. Palmer, Henry Metzger, W. H. Easterbrook, J. N. Keller, H. N. Gifford, H. F. Durant, E. J. Hall, Sr., W. D. Sargent, R. M. Bailey, J. R. Mulvane, T. D. Lockwood, C. B. Hotchkiss, John A. Seeley, J. P. McKinstry, H. L. Storke, J. M. Jackson, J. K. Dunbar, E. J. Hall, Jr., A. O. Morgan, W. W. Smith, T. B. Doolittle, C. P. Slater, J. M. Brown, R. S. Boyd, Frank B. Knight.

Letters of regret were read from Mr. Tyler, of New Haven; Jackson, of Detroit; Stone, of Cincinnati.

Vice-President Metzger was called to the chair, and the secretary read a very complete and exhaustive paper on "Telephone Statistics," presenting them in tabulated and concise form. Reports had been received from 46 exchanges, representing 47,000 subscribers. Exchanges in cities of over 50,000 furnished the most valuable information for comparison. Of such there are 41 in the United States, representing about 63,500 subscribers. Of these 23 exchanges, representing about 38,000 subscribers, reported. Twenty-two exchanges had 33,112 subscribers in 1885, and this year report 36,634, a net gain of 3,522, or nearly 11 per cent. New York gained the largest number of subscribers, 791, an increase of 15 per cent., but as a comparative gain this record is beaten by that of Richmond, which gained 76, or 16 per cent.; by that of Detroit, which gained 329 or nearly 17 per cent.; and that of Brooklyn, which gained, whose increase was 443, or 19 per cent. New Orleans shows a loss of 44, due to an opposition company, which has recently been enjoined. Lowell and Worcester both show heavy losses, the former 213 the latter 132, due to a raise in rates. Detroit seems to be the field best supplied with telephones, there being one station to every 51 inhabitants; Providence coming next, with one to every 58. At the other end of the list Jersey City has one to every 232 of her population. A number of valuable tables were presented in this report showing an increase in the number of daily connections, and giving interesting comparisons. The eight offices working the "multiple" system average 623 daily connections per operator. The remaining 14 (reported) using "straight" boards average 309 connections per operator. New Orleans reports 1,054 as their operators' average day's work. Eight multiple boards average 81 wires per operator; 15 straight boards average 65 per operator. The number of trunk lines is shown to be increasing every year, New York pays the highest average salaries to operators, viz., $13.13 per week, and Milwaukee the lowest, $4.95.

Mr. T. D. Lockwood then read a paper on "The necessity of protecting telephone exchanges, circuits and appliances from the destructive effects of intense electric currents and discharges." He said that two broad and comprehensive classes are more or less known, viz: Those in which a coarse wire electro-magnet included in the telephone circuit at the points to be protected is used to break the circuit or shunt, the instruments upon the passage of an abnormally strong current through the wires, the magnet being non-operative when the ordinary telephone or magneto-currents are passing. Second. Those in which an attenuated strip of metal foil or wire is made to form a part of the circuit outside of the portion to be protected, this having a sufficient conductivity for the ordinary currents, but being adapted to burn out, fuse, volatilize or deflagrate when a dangerous current passes. Protectors depending for their action upon electro magnets are reasonably sure in their action, and are prompt, because the magnetizing effect of a current is swifter than its heating effect. On the other hand, electro-magnets in telephone circuits interpose a much higher opposition to the passage of the telephonic currents than might be expected from their resistance only, by reason of the counter currents generated in their coils by the changes in their magnetism. Mr. Lockwood, continuing, said: I might well interpolate here that there is a method by which electro-magnets may be introduced into the telephonic circuit without exercising this pernicious effect, if the electro-magnets are connected in what we call multiple arc, that is if the line wire be brought abreast, be divided into two parts and brought abreast, one branch to one magnet and the other branch to the other magnet and led through each magnet coil individually, then joined on the other side and led on as usual—to put it in plain language, connected abreast instead of connected in tandem. The counter-current has a short circuit through those coils and does not materially affect the passage of the telephonic current, and although I had not written this the sight of Mr. Wiley W. Smith here, who has always been an advocate of that method of connection, has reminded me of it at this time.

The small electro-magnet mounted on an insulated base, provided with the usual armature, which has a lever ending in a catch, which, when at rest, holds a spring lever in place, invented by Dr. S. M. Plush, of Philadelphia, was highly commended by

Mr. Lockwood. In this the circuit is led through the magnet coil, armature lever and spring lever, so that when the armature is attracted the spring lever is liberated and flies back, leaving an opening of some 6 or 7 inches in the circuit, and preventing damage to the instruments inside of the safety appliances.

On the conclusion of this paper the convention adjourned to 10 A. M. Wednesday.

WEDNESDAY'S SESSION.

The first paper at this session was on "Legislation of the Past Year," by Mr. H. L. Storke, which reviewed, in an interesting manner, all telephon c legislation relating to the local companies.

Mr. J. E. Hockett, of Indianapolis, was called upon to state the result of the severe legislation in his State. He informed the convention that the toll system had been adopted in the larger cities, but could not say whether it was satisfactory to the Central Union Company or not.

Capt. Gifford stated that his company had closed its exchanges affected by the $3 rental law, and was now operating a few long lines connected with the Louisville Exchange at a loss, for the accommodation of certain customers.

Mr. Fay stated his experience with the Indiana law, and reviewed the whole history of it, stating that he regretted that no one was present to speak authoritatively for the Central Union.

Mr. Hall thought that in the toll system a guaranteed minimum was an absolute essential.

Mr. Fay's paper on "Cables and Underground Work" was read. He spoke at considerable length of the work in New York city, and the visit of the commission to Chicago. In the central district of Chicago, Mr. Fay said, they had one underground line 1,800 feet in length. It consists of kerite and Patterson cables, drawn into Dorsett conduits. The tests show that insulation runs down rapidly and cross talk increases.

The statement by Mr. Fay that the transmission of speech through cables was becoming less distinct each year Mr. Frost thought should be published at once for the benefit of telephone men. This change had been noticed by him.

Mr. Seeley stated that submarine cables, nine miles in length, seven-conductor kerite cables, were being experimented with in New York. The cables were in nine lengths, and when connected together worked satisfactorily. These cables were not in use every day.

Mr. W. D. Sargent, general manager of the New York and New Jersey Telephone Company, then read the following paper, which was closely listened to by every delegate:

UNDERGROUND WORK IN BROOKLYN—BY W. D. SARGENT.

The very rapid growth and accumulation of wires near our principal office in Brooklyn compelled the consideration of the underground question, regardless of the newspaper hue and cry and compulsory legislation. Unfortunately for the credit of our good intentions, no work was done until after the passage of the present underground act, in May, 1884.

It may be noted, in passing, that the sentiment against poles and overhead wires seems to have been manufactured by newspapers and underground companies with an "axe to grind," evidence of which is our present extensive system of poles and wires erected without protest from property owners and citizens.

In the summer of 1884 it was decided to attempt to place some wires under the streets. Believing that such a complex system as ours could never be fully accommodated by wires laid permanently in the ground, we decided to lay a conduit comprising a series of ducts, permitting the introduction and withdrawal of wires and cables, thus providing space for future growth; for the withdrawal of defective cables and the substitution of others, as experience determines are the most suitable.

Up to this time, no cables or wires can be had whose durability has been sufficiently tested to warrant the faith to lay them permanently underground without any expectation of being able to reach them without tearing up the entire street. While the liability to damage when laid permanently underground, may be very remote, facilities for handling cables without opening the street are worth providing for on economical grounds. In many of the systems already laid, it is customary to box the cables in wood and fill in with asphaltum or cement. The same box can just as well be left empty and the cables drawn in and out without much greater expense, provided the wood can be made durable.

In looking up the durability of wood laid underground, in which we were very much aided by the Commissioners of Electrical Subways, we found the most competent authorities agreed that the process of creosoting, when properly done, would preserve it indefinitely. Conduits of different materials, iron, cement, asphaltum, etc., were examined, but creosoted wood appeared to be the cheapest, and as durable as any. These considerations led to its final adoption for our conduit.

The form decided upon was a square box, sides, top and bottom one and one-half inch plank, subdivided into ducts, varying in number from 10 to 4, according to requirements—the divisions being made with one inch boards.

As the manholes in the first work were not very frequent, we anticipated that friction and the consequent strain of drawing in long and heavy cables might be sufficient to injure them. With the intention of obviating this difficulty, the ducts were made three inches high by two wide, and rollers were placed permanently in the bottom of each duct, for the purpose of lessening friction. This we found to answer very satisfactorily.

In the season of 1885, the Underground Commissioners assumed direction, and at their suggestion the rollers were made into small carriages, consisting of two rollers below, one above, the cable resting on the upper roller, the intention being to withdraw the carriages after the cable was pulled in, and using them for successive cables. In the more extensive work which we have done in 1886, the manholes becoming more frequent, we find that lengths of 1,000 feet or less may be readily drawn in, without injury to the cable, and without rollers or any anti-friction device. (The blue print drawing, which is here for the inspection of members interested, shows all the details, without further description.)

The general plan of distribution contemplated for the thirteen miles of conduit which will be completed this year, is to bring the cables out to poles, or on the housetops, in bunches of 25, 50 and 100, and distributing as now through the air. This method of distribution has been permitted by our underground commissioners, pending the development of something better. We are not prepared to offer any plan for introducing individual wires into the buildings.

Preliminary to opening the streets, a map was made, showing the location of water, gas and sewer pipes, from information obtained from city departments and gas companies. This information proved to be as valuable as that of the pilot who knew every rock in the channel, and when the ship struck said, "There is one of them now;" and it was in this way that we came to know every pipe in the street, that is, as we struck them.

We think it is safe to say the obstructions in the streets of Brooklyn are less than in many other cities, even of smaller size. The character of the ground is sandy and usually easy digging, but frequently obstructed by large boulders, which require blasting to remove them. There is no ledge of rock in Brooklyn. The proper way in laying out a line for an underground conduit is to dig test holes over the route desired, thus locating all obstructions and digging trench accordingly. The depth of trench with us is usually thirty inches; but owing to service pipes for gas and water and occasional large mains, we have gone in some cases to a depth of seven feet.

As to the durability of our work, time alone will tell. The first half mile of our creosoted conduit will be down two years in November, and inspection just made before the writing of this paper shows no sign of decay in the timber, and the iron screws and nails are not corroded.

The objection usually made to this conduit is that it is not water-tight. This is true; nor did we attempt to make it so. The only damage that can result from water flowing through the duct is the accumulation of mud or silt, sufficient to clog them up. In the work already done, after two years' service, a recent examination at several points showed no deposit of any kind, and we are able to move the cables freely. In order to prevent the possibility of this trouble in the more extensive work now in progress, we have adopted the plan of pouring hot pitch or asphaltum over all the joints, sealing them up effectually.

Regarding the location of manholes, these have heretofore been placed only at points of distribution and where obstructions rendered them necessary. The growth of the underground system will doubtless require manholes at the junction of all streets.

The creosoted wood (North Carolina pine) is treated and furnished by an establishment in our own city, the price under our present contract being $41 per 1,000 feet, board measure, including mill work. The conduit is made up complete by our own workmen into sections of 16 feet, which are then carted to the trench, dropped in, joined up, and covers screwed on.

Special care is taken where sections join to make the ducts continuous and in line. In addition to pitching the joints, the junction of sections is covered with felt and heavily pitched. The cost per foot of single duct laid in the trench and ready to fill in, based on the work already done, is 6 to 10 cents per foot. The cost in detail is shown by statement open to the inspection of members.

Our first trench work was done by contract, the price being 30 cents per foot, 18 inches wide by 30 inches deep, with extras for rock work and additional depth.

Work done by contract has its disadvantages, principally on account of inability to control the work as thoroughly as is desirable. For this reason we decided to do the work ourselves this year, and it is probable the cost will be less. The advantage, however, is in the absolute control and thoroughness of the work. The ordinary Italian laborers are employed under suitable foremen.

We have made a contract with D. H Dorsett for five miles of his asphaltum or concrete conduit, which is now well under way, but regarding which no figures can be given at present.

In cables we have used principally the lead covered pipe, furnished by the Western Electric, Brooks and Faraday. These are made up in fifties and hundreds, with wires twisted in pairs. The twisting in pairs is done to provide for perfect metallic circuits when they become necessary. During the time we are using grounded circuits the interference between the wires of a pair is greater than if not twisted, if they happen to be used simultaneously. The possibility of this is very remote, and don't think worth providing for.

One section of 4,500 feet, just laid by Brooks, is interspersed with braided tinsel, for the prevention of interference. No comparative tests have yet been made to determine its value. The balance of the cables are without any special device.

The first cables, drawn in in 1884, began to show trouble in about eight months, and the manufacturers were notified, their investigation finding the trouble in the terminals, except in one Brooks' cable, in which the lead pipe was found badly corroded. One section of 600 feet was withdrawn, in which we found a crack in the pipe at a wipe joint that had admitted moisture. New terminals were put on. The whole difficulty with the terminals is to get them moisture-tight. Within the last few months air and moisture-tight terminals have been furnished, which we believe will prevent future trouble.

The durability of lead pipe is a very important question. The corrosion of the Brooks' lead pipe has now reached one-eighth of an inch in depth, and the indications are that the whole pipe will be consumed. Opinions differ as to the cause of this corrosion. The product is undoubtedly carbonate of lead, and Prof. Plympton says it is caused by the action of water-gas, which collects in the ducts. Other authorities believe it is due to the vapor of acids in the creosoted woods. The pipe was made by Tatham Bros., of Philadelphia, and is said to be pure lead.

The Western Electric cables have a small percentage of tin, which was put in to stiffen the pipe; but it seems to serve another useful purpose, inasmuch as their cables laid alongside the Brooks show no sign of corrosion. It is fortunate that a remedy is so immediately indicated for what promises to be a serious evil.

Our greatest length of cable underground up to the present time has been 2,400 feet; interference is very slight, and retardation not perceptible. The trunk wires between New York and Brooklyn work through two miles of cable without serious difficulty, and we don't anticipate our troubles will begin until we get beyond that point. The longest cables laid this year are 4,500 feet, and tests show that we shall have no difficulty in working them. The insulation varies from 50 megohms to 500 per mile. Static capacity not measured.

We expect to be able to maintain our pole wires for a reasonable time to insure durability of cables, and to retain them entirely where the wires are less than 50. New poles will necessarily have to be put up to aid in distributing from the underground, and we are now putting up some for that purpose

One of our Underground Commissioners is now in Europe, and in a letter from him dated Milan, he writes as follows: "I have heard of no underground telephone wires since I left London. I am a little in doubt about a few in Berlin, but the rule is, 'mount them on the housetops.' The government can compel submission of the citizens, but awards him some compensation Perhaps the most striking incident of the journey was finding a new line of telegraph poles in the streets of Antwerp; I have ordered a photograph of them Preece says he never knew a case of failure of well-creosoted timber through decay."

This was written after the writer had been at Liverpool, London, Brussels, Antwerp, Cologne, Weisbaden, Heidleberg, Frankfort, Berlin, Munich, Lucerne, Milan. This seems to indicate that the problem for underground wires for a telephone system is quite as difficult a question there as it is here.

W. D. SARGENT.

Capt. Gifford had experienced trouble from the lead covering on the cables oxyidizing.

Mr. Patterson, of the Western Electric Company, was called upon, and stated the result of several of his experiments.

Mr. Hotchkiss was called upon, and said that the size of the conductor should not only be enlarged, but the body of insulating material around that conductor should be increased to secure the best results.

Letters from M. Berthon, of Paris and Dr. S. M. Plush, of Philadelphia, were read and the convention adjourned. The afternoon was devoted to the boat ride down the Mississippi tendered by the Bell Company, of Missouri, the visitors returning to the city in the morning, some of them much inconvenienced by the delay in returning as there was no provision made for commissary supplies.

THURSDAY'S PROCEEDINGS.

Mr. Metzger called the meeting to order at 10 A M. and the secretary read the following paper, by Mr. A. S. Hibbard, on long distance telephoning:

(*Continued on fifth page.*)

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CHARLES W. PRICE, Associate "
LOREN N. DOWNS, President.
ANDREW J. DAM, - Vice-Pres't and Treas.
C. C. HASKINS,)
GEO. A. HAMILTON, - Consulting Electricians.
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NEW YORK, SEPTEMBER 18, 1886.

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The meeting in St. Louis last week of the National Telephone Association was well at ended and a success in every way. Many of the papers read were of unusual interest.

Not only the local, but the general Brush Company as well, took a great interest in the convention at Detroit, and at every opportunity did something handsome in the way of entertaining. President Stockley, Secretary Swift and Superintendent Possons were all present, and took a lively interest in the proceedings. We hope that all the other parent companies will come to the front and participate in future conventions. The Brush, United States, Thomson-Houston, and Jenney companies have always taken an interest.

It is a common practice, in running wires on the fronts of buildings, to place the insulators directly on the front or on short insulators. Awnings or cornices are often near. In case of a heavy fall of snow, especially if the same be damp, there is danger that there be a path for the current to the building. The wires should be kept well away from all projections which could catch snow, and, in cases where this cannot be done, waterproof wire of high insulating qualities should be employed.

The Secretary of the Light Committee, at Montreal, has received from ratepayers large numbers of applications for additional electric lights in the districts in which gas has been superseded. Mr. Badger, superintendent of the Fire Alarm Telegraph, is just now busy preparing his report upon the necessity or otherwise of the introduction of further electric lights.

An important step because of the example was recently taken upon the Valmondois (Department of Aisne) in France where, for the first time in France, the railroad telegraph has been succeeded by the telephone, and a French contemporary tells us that this example will, like enough, be followed by many other railroads with the consent of the government railroad authorities. The Societe Generale des Telephones, which has constructed this line, performed a work some what similar last year upon the canal of the Youne, where forty telephonic stations were established between Auxerre and Chamcey upon a line of 65 kilometers (about 45¼ miles.)

In both of these instances the telephonic service has given great satisfaction, and has proved to possess superior advantages over the old telegraphic service in preventing accidents and facilitating business. It has shown itself to be the wanting factor by which the work of the stupid and inattentive operator may be corrected before too late.

A SEA-GOING EXPOSITION.

The news which comes by cable, that the French are fitting out a floating exposition of their manufactures to please and astonish our Central and South American neighbors, is at once interesting and instructive. The French people have perception as well as ingenuity. They know that a wrecked ship comes to the shore, the shore does not go to the ship; and while this is rather a severe term to apply to the industrial depression in France, which, by the way, is not nearly as bad as it is in England, it is absolutely necessary in order to avert mercantile disaster, that her merchants seek new fields in which to dispose of their wares.

It is the *Syndicat de l'Industrie* that has proposed, and a committee of that body which is entrusted with the task of carrying out this novel scheme of industrial development.

A splendid steamship, the Sarthe, of 3,900 tons measurement, has been selected for the expedition, and is now being fitted up to suit its requirements. Large quantities of machinery, of a new pattern, especially that pertaining to the utilization of electricity, will soon be placed aboard in such a way that it can be exhibited conveniently. There will be lamps of the arc, incandescence and Jablochkoff types, carbons and carbon-holders, wires of all descriptions, dynamo machines, primary and secondary batteries, and descriptions of articles required to properly fit up and maintain electric light and power stations, telephone, telegraph, and time stations.

There are some enterprises which are good but not original, and others that are original but not good. This one, however, may fairly be said to be both new and good, and its organizers have our hearty good wishes for their success. There is a large and good field in Central and South America for electrical and other mercantile enterprises, if only the people can see them. The South Americans are a strange people. They can hear of a thing and learn all about its advantages without showing any desire of possessing it. In them one of the principal laws of political economy is violated. There is no demand until the supply appears on the ground. They must see a thing before them and get accustomed to it in operation before they exhibit any desire to possess it. Again, they insist upon having goods put up as they want them and will take them in no other way. In fact, to suit them one must go to them, they don't visit the world's market themselves. The Germans and the English learnt this long ago, and have for years had agents stationed at all the cities and considerable towns along the Spanish main to whom goods are consigned, made and put up in the way the natives like to have them. Because of this, the Germans and English are doing all the business down there. Now the French are about to make the attempt to show the superiority of their manufactured goods by means of a floating exposition.

Is it not about time that American manufacturers, especially those making electrical goods, should make some effort to get some of this trade? which, because of its geographical position, belongs naturally to us.

SAVING AT THE SPIGOT.

There are on the market to-day a number of electro-mechanical devices built for the avowed purpose of saving current energy, and used on arc light circuits where incandescent branches are run.

Nearly each one of these has its own specific name by which it is advertised and sold, and in each case the ingenuity of the inventor has evidently been taxed to find a suitable name for his apparatus, which name, while perhaps perfectly justifiable, and one the fitting of which is demonstrable, still has a premeditated indirect deception at bottom. It is not the intention to designate these individually, as the object of this article is not to decry or belittle any invention; but to appeal to the good sense and uprightness of inventors, and to demand, respectfully, but firmly, a fair show and no favor for any and all inventions.

There are plenty of published records of light per horse-power, which never were realized, because the methods adopted for the purpose were designedly arranged to result in a fraudulent showing for the sake of business.

There are tests shown nearly everywhere by motor inventors, who claim to demonstrate by means of a lever, used as a brake, the wonderful efficiency of their machine; when a moment's thought must convince anyone that no two persons with such appliances would be at all likely to arrive at the same result. A problem where the three elements of leverage—weight, fulcrum, and lever are changed at each successive test may muddle and deceive a purchaser once—but never the second time.

He who puts upon an arc circuit a lot of incandescent lamps, in any form of "multiple," "derived," "series," or any combination of these circuits, knows—or if he does not, heaven help him—that he would utter an untruth, should he make the statement that when a portion of the lights were put out, either intentionally or by breaking them, that the current belonging to that lamp or lamps is saved because it is diverted through a resistance coil instead. To claim that by diverting the current from lamps not in use at any time the life of all such lamps is prolonged, is proper, is legitimate, is true.

But to arrange a series of, say, ten lamps, with a contrivance for equalizing the circuit, and then show that by extinguishing one of these there is no perceptible increase of brilliancy in the other nine—all on account of the contrivance—and then to claim or assume that to shut off one-tenth of a plant of a thousand lights would result similarly, would be a trick which would sooner or later recoil upon the inventor.

So, too, as has been done by so many that the original inventor has been lost, so, too, is it a fraud, a delusion and a snare for anyone to make a test for horse-power and efficiency with other machinery or idle shafting, besides the dynamo or motor running at the same time; and the greater the disproportion between the power consumed by the electrical apparatus and the other machinery or shafting, pulleys, etc., the greater the liability of error. No one ever uses hay scales to weigh diamonds.

If statements which have sometimes been made—and, be it understood, not one, but many inventors on both sides of the Atlantic have made the claim—that a number of arc lights, presumably of standard luminosity, have been run with one horse-power, then is perpetual motion possible; for in such cases it has been repeatedly shown that the more lights were placed in the circuit, the easier the dynamo ran, until, according to the related experience of one who was chasing this particular phantom, "the infernal dynamo came near running away, and we just quit."

So certain as there are laws, immutable and positive, which govern all the phenomena of electricity, so surely is it that the inventor or the agent of a system who only claims what he can honestly demonstrate, will in the long run reap the reward of his honesty. And it is equally sure that a system, whether it be for either form of lighting or for power, or, for that matter, any of the multitudinous applications of electrical force which is foisted upon the public under misrepresentation, must in time bring the whole fraternity of its advocates into disgrace; and they will learn too late that they have wasted at the bung hole while saving at the spigot.

TURNING OFF THE GAS IN PARIS.

The splendid success recently had in lighting up the Paris Grand Opera House with 8,000 Edison incandescent lights has attracted more attention in that city than any installation yet exhibited, and, if the utterances of the French press are to be taken literally, the *Compagnie Parisienne du Gaz*, has at last shown an inclination to hedge on the subject of gas *vs.* electricity. Indeed it is preparing to enter the lists of electric light projectors, and, with an enterprise truly American, has determined to supply electric light where it is wanted instead of continuing its old policy of supplying gas or nothing. It will be well for it if it adopts this policy at once, because if the Paris journals read the signs of the times aright, there will shortly be a very large demand in that city for the electric light. Human nature seems to be the same the world over. We can well remember when the first electric lights appeared in the New York shop windows and over the doors. It was looked upon as a mere experiment, the continuation of which would soon prove more trouble than it was worth, and the neighboring stores took no stock in it. Soon, however, it was discovered that it was attracting the attention of customers and the general public to such an extent that its users were compelled to enlarge their stock. Owing to the brilliancy of the light pedestrians could walk by stores of the same character lighted by gas without even seeing them, so attractive was the brilliant illumination further along. They clustered and fluttered about it as moths do about an oil lamp. That settled it; the neighboring stores must have it, and the inquiry and demand for the light spread apace until now, when, as soon as the electric light appears in one part of a locality in an American city, it spreads from store to store and from street to street.

The same phenomenon was recently observed in Paris, and to-day installations of electric light, both arc and incandescent, are spreading rapidly from one quarter of the city to another. Many large halls and public gardens are being fitted with it, and Dr. Gariel, in a conference at the l'Exposition d'Hygiene, recently added another pang to the sufferings of the gas syndicate by declaring that the electric light and not gas would be the light of the future.

On this subject the *Journal des Debats* says: "It was in the spirit of prophecy but scarcely in the role of seer that Dr. Gariel pronounced electricity to be the natural successor of gas. For any man blessed with ordinary sight can see that this change is bound to come without the assistance of doctors of medicine or philosophy. Gas lighting has many faults, and if costliness is not one of them, inefficiency and insufficiency are faults which are conspicuously absent in the electric light.

Mr. Graetzel has succeeded in producing pure magnesium by an electrolytic method at a price much below the rates at which it has hitherto been sold. Serious thoughts have thus been awakened of employing it for ordinary lighting purposes. The Bremen factory (Germany) of aluminum and magnesium, which uses Graetzel's processes, has just organized an exhibition for magnesium lamps with clockwork movements. Two prizes of $125 and $50 will be awarded to the makers of the lamps which shall be adjudged the best and most practical.

(*Continued from third page.*)

LONG DISTANCE TELEPHONING AND THE PRESENT OPERATION OF TOLL TELEPHONE LINES, BY A. S. HIBBARD, MILWAUKEE.

A review of the work of the past year in the department of toll lines operated by the companies forming this association seems to present but little that is new or interesting. No great amount of new work has been done. A number of the companies have made, to them, important extensions, and an improvement in the character of the work is apparent everywhere. The cheap lines, built three and four years ago, are proving burdensome in the cost of repairs, and, in many places, are being replaced by new and better lines. The problem of long distance telephony, however, is no nearer a solution than it was a year ago, and it may be doubted whether the gradual occupation of territory by local companies will be found the means of solving it. The most apparent reasons for this are, first, the systems to-day consist of single wire lines; and second, the limit of distance, in the successful working of such lines, is variable and dependent upon conditions not governed either by the parties owning or those attempting to use them. In our exchange service we guarantee to each subscriber the means of quick, certain and successful communication with any other. In our toll line service we would like to guarantee to patrons at each town an equally perfect means of communication with any other town. At present we are obliged to qualify our offers, and can give the perfect service only, if the line is not busy, or not noisy, or is free from "cross talk," or the instruments at both ends are in perfect condition and the station wanted is not too far away. These limitations are most confusing to the would-be patron, and must produce in his mind a series of just so many doubts concerning the efficiency of the service, a condition of things certainly detrimental to its popularity. In some localities better results are obtained than at others, but much is yet to be done to make toll line service perfect and popular with the public.

In this condition of the service a seeming paradox is found in the fact that the earnings of the established toll lines are increasing, the results for the past over the previous year showing a marked increase. This I attribute largely to the fact that the public is becoming educated in the use of the telephone, and obtains much more satisfaction in the use of long lines than ever before. The difficulties in perfecting long line service have remained in *statu quo*, and patrons have evidently determined to use the lines and encounter the troubles incident to them, the best possible proof of the great conveniences of such service. Among the improvements asked for are: Enough wires to accommodate everybody at the most busy time, no induction, no noisy wires, no weak effects, and (always) cheaper rates. Any one of the above items furnishes, at least, food for reflection. In the present system of single wire lines, a second wire to any given point necessitates a new line complete on a separate route.

In most cases the limited number of available highway routes would prevent the extension of more than three or four wires, and, at the "busy time" mentioned, these might prove insufficient. The "noisy wires" and induction troubles have certainly not been surmounted, and we still must put up with weak and unsatisfactory effects. In rates we find it impossible to compete with piratical telegraph companies.

It seems, therefore, that, at every issue, we fail to meet the above noted public demands, and yet the public use of toll lines increases. This is certainly conclusive evidence of the great service of such lines to the public and the great future of successful long distance telephony. The various companies are apparently striving hard with difficulties presented, and are experimenting and improving as rapidly as possible, the net returns on their investments in toll lines evidently warranting their best efforts.

The following is a summary of some of the more important details of toll line service as reported by twenty-two representative companies, and is a fair showing of the condition of the toll line systems now in operation. In its present imperfect form this information will be of but limited value even for purposes of comparison. I present the report, however, in the hope that it may be of service, at least, to future statisticians.

Name of Telephone Company.	Mileage of Poles.	Mileage of Wire.	Exchanges Connected.	Subscribers at These Exchanges.	Toll Offices Connected.	Average No. of Messages Monthly.	Average Rate per Message.	Average Monthly Gross Receipts per Mile of Wire.	Longest Line Worked Successfully.
Central Union	7,655	10,460	122	15,500	614	68,900	2	1 45	75
Michigan Bell	2,238	3,421	68	7,295	203	40,000	20	2 39	145
New England	2,053	3,036	88	13,247	272	26,409	20	2 37	100
Wisconsin	1,942	2,538	65	4,288	163	11,953	28	1 98	199
New York & Pennsylvania	1,600	2,300	22	2 236	281	20,000	20	1 82	60
Central New York	1,561	1,903	16	1.412	325	22,858	15	1 80	60
Cumberland	1,157	1,392	17	2,821	134	8,800	25	1 60	65
Empire State	733	1,164	11	990	95	6,622	33⅓	1 39	80
Great Southern	608	936	6	1,311	94	5,547	32	1 89	142
Buffalo Bell	614	812	11	3,343	10	9,850	19	2 29	75
Delaware & Atlantic	675	788	50	2,073	28	7,500	20	1 69	65
Pennsylvania	488	605	33	2,360	...	2,365	15	59	74
Chicago	482	1,189	10	4.676	63	7,600	25	1 96	100
Nebraska	451	491	26	2,308	22	6,498	57	3 54	111
Central D. & P. Co., Pittsburgh	413	850	30	3,338	37	....	25	1 43	135
Ohio Valley	370	510	3	1,585	32	3,640	22	1 58	156
New York & New Jersey	327	1,717	37	5,465	45	11,500	13	84	85
Central Pennsylvania	317	448	15	2,578	20	2,591	24	1 47	100
Colorado	294	294	4	1,151	6	7.194	18	4 52	114
East Tennessee	186	192	7	708	21	1,650	20	1 72	90
Missouri and Kansas	186	186	6	3,096	...	.....	25	6 31	96
Missouri Bell	74	107	3	2,100	21	2,840	21	5 63	43

The high average in gross receipts of the Colorado Company may, perhaps, be accounted for by the fact that in Colorado the lines traverse a large district not reached by telegraph lines, and written messages are handled. The Missouri & Kansas Company state that their "odds and ends" in toll lines are not accounted for, and possibly their very high average in earnings may be due to this fact.

The longest line worked regularly and successfully is again reported by the Wisconsin Telephone Company, and I desire to offer especial assurance that this figure is not the result of guesswork.

In the reports of toll line expenses the figures differ too widely to be of value in a comparative statement. It may be said, however, that 33⅓ per cent. of the gross receipts is not a high estimate for toll line expenses. Some companies, indeed, show averages of 40 and 50 per cent.

The possibilities of service on a single wire have been reckoned at 80 messages per day. While one or two companies most successful in this work report daily averages of their busiest wires of 40 and 60 messages, I think an average of 20 messages per day each will be found nearly correct as representing the present work of what we call busy wires. At an average rate of 25 cents per message, a busy line will earn $3.33 per day, after deducting 33⅓ per cent. for operating expenses. At a cost of $75 per mile, such a line may be 133 miles long and pay a return of 10 per cent. on the investment. It frequently happens that there are demands for service between important points which ten wires would not accommodate. Such demands, however, come only at the busy time of day, a period usually not covering more than three hours, and if ten wires were provided the majority of them would be idle the greater part of the day. As comparative with a 20-message per day average for one wire between two busy points, I doubt if a system of five wires would average more than 50 messages per day, or ten for each wire, thus reducing the 10 per cent. investment limit to 66 miles.

The margin for profit in the present lines may be found in the fact that some lines cost less than $75, are less than the above limits in length, and do average 20 or more messages per day.

The present approved telephone line, for single wires, may be said to be of hard-drawn copper wire, weighing from 100 to 300 lbs. to the mile, strung on glass insulators, with 30 cedar poles to the mile, the poles to be at least 25 feet long, 5 inches in diameter at the top, and set 4 feet in the ground.

It is quite remarkable that in the past year nothing new has been developed regarding the "induction" phenomenon, and no practical remedy has been found for this uncertain and unfortunate evil.

During the past four summer months it has been noticed throughout the Northwestern States that there has been less trouble from noisy wires than ever before during the same season. Extended inquiry and pretty constant observation has established the truth of this assertion. The reason for this I attribute to the unusually dry season. There has been apparently but little difference in the electrical condition at different points, few storms, clouds, or electrical phenomena of any character. The crust of the earth has been baked hard and dry, forming a most imperfect conductor for the equalization of tension. The swamps and low places have become dry, and even the streams have diminished in size. Owing to the above causes the currents usually traversing these surface conductors, earth, water and air, have become of less volume and intensity, and the effects, as produced in the telephone, have decreased in like proportion. In further support of this theory, I desire to cite an instance of a line 14 miles long, formerly extending along the bank of the Chippewa river in Wisconsin, connecting two exchanges, and much used.

This line was the very noisiest I have ever known. During the summer months it gave forth a variety of sputtering and frying noises continuously, day and night, and was a great annoyance. Last fall we were obliged to change the route of the line materially, and I determined to abandon the river bed and get up on the high ground, thinking only to escape lightning troubles and washouts. Much to my surprise this spring and summer I found the new line free from noises, and entirely quiet, while the portion of the old line now remaining sputters and frys away as before. It certainly would appear that the river, as a natural conductor, produces the disastrous inductive effects.

The "cross-talk" trouble is to-day just as bad as ever, and two parallel wires on one line of poles cannot be worked satisfactorily at the same time for even a distance of ten miles. While subscribers put up with it and try to get used to it, they certainly do not like it, and the amount of invective hurled at the "man on the other wire" shows no diminution. As modestly as possible I desire to lay claim to the discovery of a seemingly ludicrous but really quite effective remedy for "cross-talk."

It has for a base an apparent "differential" in the appreciation of any two different languages. When an unsuccessful attempt is being made to work two parallel wires at one time and things are getting warm at each end, instruct your operator to cut out one wire, and then ask the parties on the other if they can speak German, and, if so, have them go ahead entirely in German. Then cut in your second wire and both conversations will proceed without clashing, one being in English and the other in German. There is perhaps no limit to the combinations of languages which may be made effective for this scheme, and as I am uncertain as to whether it is based on the "undulatory" or the "make and break" principle, I resign all claims as the inventor. Up to the present time the toll line business of the country has been developed entirely by the single wire systems with all their disadvantages in delay, inductions, poor result and limited facilities. There has not yet been offered what may be called a perfect or popular toll line service, and the possibilities of such a service have not been clearly shown by the present results. When long distance telephony, in a perfected form, is regarded as much of a certainty as railway travel or the U. S. mail service it may be assumed that a different class of patronage will be developed. The perfected service free from distracting annoyances will certainly be regarded as one of the very greatest of modern conveniences and must receive the most extended patronage of a progressive people.

On motion of Mr. Fay the paper was accepted and ordered to be printed, and it was resolved that the thanks of the association be tendered to Mr. Hibbard.

A long discussion followed, which was participated in by Messrs. Keller, Fay, Barney, Durant, Lockwood, Sargent, Ker, Metzger, Schlater, Hall, Drake, Gifford, Wiley Smith, Seeley, Easterbrook, and Bailey.

Mr. Schlater said: The Bell Company, of Canada, has about 3,600 miles of trunk line wire and the result is that they return a net profit, allowing for depreciation, of about 8 per cent. We use No. 14 copper wire, and we have to leave the telegraph lines, which increases the distance we have to cover somewhat. The No. 14 copper wire is used on the main routes, but we also use No. 9 iron wire to a large extent, and I believe the results from the No. 9 wire are nearly, if not quite, as good as over the copper wire. We work, commercially, 225 miles

Mr. Gifford expressed the opinion that the matter of long distance telephony would be governed by financial rather than scientific considerations. Our most profitable lines are those 15, 20 50 miles long, and those which connect suburban points with the business centers to which they are tributary. He thought it doubtful whether long lines would ever be profitable. Between two such places as New York and Chicago a line would no doubt pay.

Mr. Wiley Smith—Our Kansas system includes six exchanges in Topeka, Lawrence, Kansas City, Leavenworth, Atchison and St. Joseph Those six exchanges are connected by 150 miles of wire. That is the total distance between exchanges. We are doing, I think, more business between those cities than both telegraph companies do. Our business has increased so that we have had to build a second wire between Kansas City and Leavenworth, and a second line between Kansas City and Topeka. Our last wire between Kansas City and Topeka is over 80 miles in length—a copper wire. It talks very nicely, indeed, and we anticipate a handsome increase in our business.

Mr. Fay—I believe that between any two cities in America a limited business can be done if the service can be made certain and accurate, and the price should be made high enough to cover the limited demand. It strikes me that between large cities a call service might be organized to call subscribers or anybody else.

Mr. Hall—We are experimenting on a line between New York and Philadelphia, and at the next meeting I will present a paper embodying the results of our tests. The line is of 45-foot poles, made for seven cross-arms. The cross-arms are intended to carry ten wires each, and we have now on the line one No. 8 wire on the top pin and twenty-four copper wires. We have twelve No. 14 standard gauge—102 lbs. to the mile; eight No. 12 standard gauge, about 175 lbs. of copper to the mile; and four miles of sixteen standard gauge, about 66 lbs. to the mile. We put these different-sized wires on for the purpose of experimenting to see whether we obtain materially better results from the use of larger conductors. The capacity which that gives us for business will enable us, when we commence service, to give it promptly and efficiently. There is no perceptible difference in talking between New York and Philadelphia between No. 16, No. 14 or No. 12. The distance is about 100 miles of pole line, and a little over three miles of submarine cable. But when you couple the wires back,

so as to make longer circuits, you do begin to notice a difference. For one hundred miles sixty-six pounds of copper is ample. Beyond that it is desirable to use a heavier gauge. I think you can go 300 miles of metallic circuit with No. 16 standard gauge of copper and carry on a thoroughly good conversation. But there are mechanical objections to using such a small gauge. I think that as a standard for trunk lines it would be perfectly safe to take No. 14 wire of about 100 lbs. of copper to the mile, both for electrical and mechanical reasons.

Mr. Easterbrook offered a resolution, which was unanimously adopted, expressing the thanks of the association to Mr. George F. Durant for the interesting and enjoyable excursion to Crystal City, and for the many other courtesies shown by him to the members during their stay in St. Louis.

Mr Durant presented an abstract, illustrated by blue prints, of a paper written by Col. Flad, President of the American Society of Civil Engineers and President of the St. Louis Board of Public Improvements, descriptive of a plan of the author's for an overhead system of supporting and distributing by means of towers and cables, electric light, telephone and telegraph wires.

Mr. Durant's synopsis of the paper was listened to with much interest by the members, and the secretary was instructed to prepare an abstract of the paper to be printed with the proceedings of the association.

The convention then adjourned.

Exhibits were made by the Western Electric Company, Standard Electrical Works, Day's Kerite, Waring Cable, Railway Telegraph Supply Company, Bridgeport Brass Company, Visual Signal Company of New Haven (Brewer & Smith), Wittenberg's Telephone Register.

The Attendants.

The gentlemen attending the convention were: C. N. Fay, Chicago; J. R. Mulvane, Topeka; W. W. Smith, Chas. McDaniel, Kansas City; E B. Field, Denver; J. J. Dickey, Flemon Drake, Omaha; C. H. Barney, T. B. Doolittle, Jno. A. Seeley, C. W. Price, R. W. Ryan, T. C. Martin, E. J. Hall, Jr., Col. Geo. L Beetle, C. B. Hotchkiss, H. L. Storke, D. I. Carson, New York; E. V. Cherry, Cincinnati; C. P. Sclater, Chas. F. Sise, Montreal; W. D. Sargent, Brooklyn; A. B. Uline, Albany; W. N. Easterbrook, New York; Frank B. Knight, New Orleans; J. B. Kerr, Harrisburg; W. A. Hovey, J. N. Keller, C. J. French, T. D. Lockwood, Boston; A. O. Morgan, New York; H. N Gifford, Louisville; Geo. F. Durant, E. A. Hitchcock, St. Louis; H. P. Frost, New Haven; J. P. McKinstry, Cleveland; W. A. Childs, New York; C. F. Annett, Salt Lake City; T. B. Doolittle, H. D. Stanley, Bridgeport; R. M. Bailey, Williamsport; Geo. Manson, New York; C. A. Brown, W. R. Patterson, F. W. Harrington, Chicago; C. D. Crandall, Kansas City; E. T. Gilliland, New York; M. R. Wolff, Wheeling; Frank Shaw, New York; J. E. Hackett, Indianapolis; Henry Metzger, Pittsburgh; E. J. Hall, Sr., H. C. Palmer, Buffalo; J. K. Dunbar, Austin; R. S. Boyd, Boston; J. M. Brown, Washington; H. T. Crane, Cincinnati; J. M. Jackson, Chicago; F E. Degenhardt, Pittsburgh.

—— Six weeks ago, by special permission of the directors of the Lake Shore Railroad, Howard Pyle, inventor of an electric locomotive headlight, placed one in operation on engine No. 411, running from Cleveland to Erie, drawing train No. 2 east and No. 5 west. Mr. George Paul, master mechanic of the Cuyahoga Falls Electric Manufacturing Company of Locomotive Headlights, was placed in superintendency of the light, and since the time it was put on the engine has been accompanying it on each trip of the engine. All the passenger engineers running on this division have now had an opportunity to test the headlight, and all express unbounded satisfaction.

Legal Relations of Electric Light Companies, Telegraph and Telephone Companies and the Patent Office.

BY ARTHUR STEWART, BALTIMORE. READ AT THE ELECTRIC LIGHT CONVENTION, AT DETROIT, AUG. 31, 1886.

To the President and Gentlemen of the National Electric Light Association — As chairman of the Legal Committee, permit me to present the following report upon, first, the legal relations of an electric light company to a telegraph or telephone company, in relation to the interference with telephone business by electric light companies; and, secondly, the relation of electric lighting to the patent system.

1. How far has a telephone company a legal remedy against an electric light company for interference with business due to a necessary incident of electric lighting, such, for instance, as induction?

In approaching this question, we are met by one fact which exists in almost all cities of this country, and that is the fact that the telephone companies are in almost every case in full possession of the field, and, when an electric light company comes in and causes any disturbance of business, it is interfering with vested and established rights. But leaving this situation out of the question, because it is not a controlling one, we must fall back upon the principle that no man can use his own property (within reasonable limit) so as to injure that of another. I say within reasonable limit because this doctrine can be carried too far. The demands of modern civilization are such that, even if it were impossible to conduct a telephone and electric light business in the same district without very serious injury and obstruction to telephone lines, it can almost be said with certainty that the public would put up with very bad telephones rather than be deprived of electric lights. But fortunately this is not the case. Electric light wires and those of telephone and telegraph companies can be used in the same district, and if properly arranged will interfere to a very small extent with one another; but this harmonious operation of the two systems is only possible when some care is taken to prevent the difficulties, such, for instance, as hanging the wires far enough apart not to influence one another injuriously. If, however, an electric light company were to persist in placing its conductors so close to telephone wires as to cause injury to the telephone business, there would certainly be a remedy by way of injunction and damages at the command of the telephone company. Just here let me say a word on the subject of the oft-attacked underground systems. A law which requires all wires to be placed under ground would entail the adoption of some system in which wires of the different classes placed in the same subway would be so separated that they would not produce any inductive effect upon one another.

2. The second point upon which your committee is called upon to report is that of the relation of the electric lighting to the patent system. Some of you who may have some granger interest will doubtless be surprised to hear me say that to the patent systems of this and other countries alone you and the people of the world owe almost everything in the shape of improvement in electric lighting which you now possess.

Such men as Wendell Phillips have said most truly that to our patent system we owe our superiority over the periods and nations of the past. Many were the arts and processes known to the ancients of which we see the fruits, but the methods are lost. Why? Because there was no system existing at the time that the inventors lived which offered to them any inducements to disclose their secrets. They kept them, therefore, locked in their own breasts, or communicated only to a few chosen compatriots, all of whom were bound by a solemn oath, on penalty of their lives, not to disclose them. Some vicissitude of life swept all those possessed of the secret away at once and they were lost. Under our system such a thing is impossible.

It is not my purpose to go further into eulogy of the patent system of this country, for I know that most of you have had such practical and profitable experience of it as to need no argument from me to enlist you in an effort at its support and protection.

There is, as you are all very well aware, a large class of voters in this country who, from some cause, are violently opposed to the whole patent system as an element in our national life and policy, and unfortunately this class is so large and politically powerful that the halls of Congress are ringing with attacks upon the system, and the courts of the country are seriously affected by the outcry, so much so as to have become technical and much less liberal than formerly in their construction of patents. And we, gentlemen, who from the standpoint of our daily life see the great, the immeasurable advantages that have been and are being derived from the operation of the system, are called upon to make our voices heard in its defense, to appeal to Congress to support the growing industries of the country by protecting their developments, and to the courts to be liberal in securing to meritorious inventors the full benefit of their contribution to the knowledge of the world.

There are several special points to which I will direct your attention, and if the gentlemen think well of the idea we would suggest that the weight of this convention be thrown into the scale to carry them into effect.

Improvements suggested in the U. S. Patent Office:

1. The burden of work that is imposed upon the examiners in the Patent Office has so rapidly increased of late years, that the force now employed is entirely inadequate to accomplish what is assigned to them.

For years past the Commissioner of Patents has been petitioning Congress to authorize him to expend some of the large accumulated surplus which is lying in the U. S. Treasury to the credit of the Patent Office —some $350,000—in the employment of force adequate to perform the work daily pressing upon him. But so far his petitions have been unheeded. The department that suffers most by lack of force is the electrical, because that one is most heavily burdened just at this time.

2. Another subject of special interest to electricians is a suggestion made by the Commissioner of Patents in his last message to Congress, and that is, a request that money be appropriated to erect an electrical laboratory for the use of the examiners in the electrical department and for applicants. This is a very important matter to all persons applying for electrical patents, as it will afford facilities far greater than ever existed before for the examination and demonstration of electrical inventions, many of which require that the examiners shall be carefully instructed by the applicant in order that a proper patent may be procured.

3. Some plan should be devised by which a higher class of men would be employed as examiners in the Patent Office. At present the men are fairly good, but with the exception of the principal examiners, few of them stay more than a very short time in the office. In fact, it has become a custom that young men will go into the department, and after staying there for one or two years will resign and establish themselves, either in Washington or elsewhere, as patent solicitors.

It is very desirable that the examiners in the Patent Office should be the very best and most experienced men that can be procured for the purpose, and when once secured they should remain in the position for a number of years.

To accomplish these results:

The suggestions that occur to us as most likely to secure them is to increase the pay, and provide for the pension of examiners after a certain number of years of faithful service. In addition to the foregoing it would be well that a system of annual or biennial examinations, such as exist in the navy, be instituted, because it is very important in the interest of applicants that examiners should not only be thoroughly educated and intelligent men, but that they should keep fully up to date in all matters with which they have to deal, both in science and law.

Improvements in the patent system, relative to the trial of patent causes, and the reduction of the cost of litigation to the owners of patents:

1. In the trial of patent causes great difficulty and loss of time is experienced, as well as great expense imposed upon the litigants, by the necessity for the employment of experts, whose duty it is to elucidate the subjects in question for the benefit of the court, and to set forth the facts as well as their opinions, before it, in such shape that it will be able to fully comprehend them, and to apply to them the law for the purposes of decision.

It is the custom in this country for each party, plaintiff and defendant, to employ their own expert, who examines the case from their standpoint and gives his opinion accordingly.

The reputation and ability of these gentlemen determine the cost to the litigant of their services, and it usually happens that their bills run into many hundred and often thousands of dollars. For the purpose of overcoming this difficulty it has long been the custom in the English courts for the judges to call upon experts to assist them in the trial of patent cases. These experts are employed by the Crown, and are not permitted to take employment from either litigant.

The benefit of this system is apparent. Instead of being compelled to encumber the record with a large mass of expert testimony, as well as charge the litigant with the high cost of the same, he will be enabled by simply proving his facts to go to a Court of Equity and argue his case before unprejudiced and sworn experts, trained in the art to which his patent appertains, who will instruct the Court as to the facts, and leave it free to determine the law unencumbered by a mass of technical matter often little understood by the judges.

One of the uses to which these experts could be advantageously put would be to make them judges in interference cases, and other matters relative to applications for patents in the districts in which they were located, so as to afford additional facilities to applicants at reduced cost.

You have all doubtless had some experience in procuring legislation in Congress, and have found that the best and most important measures will languish and be neglected unless some one makes it their business to keep the ball rolling, and unless all those interested in a measure will unite to have it taken up and favorably considered.

Some of these suggestions have been repeatedly before Congress in the reports of the Commissioner of Patents, but as a prominent Washingtonian said to me some time ago, when I asked him why they had not been passed: "What is everybody's business is nobody's business; they have therefore been overlooked because they were not brought prominently forward by some one who was personally interested."

We would, therefore, request that if this convention think well of the suggestion of this committee they authorize the committee to prepare such bills for Congress as will carry them into effect, and then, when copies are furnished to the members, they will individually use all their personal influence with their Senators and Representatives to have the bills passed and made laws.

In this way great good can be done by this convention, which will be of lasting benefit to all the members as well as to all the inventors of this country.

LEGAL BUREAU.

We have been requested by the Committee on Bureau of Statistics to submit a supplemental report to theirs, upon one of the heads upon which they have touched, that is to say, upon the "Legal Department of the Bureau," because they consider that it would very properly fall under the subject of the "Legal Relations of Electric Lighting to the Patent System," which was assigned to your committee for consideration.

1st. What should the Legal Department be, and what is the need for its creation?

The Legal Department, as suggested by the Committee on Bureau of Statistics, would be a branch of the Bureau of Information, to be in charge of a competent person, skilled in electrical and patent matters, and to be always at the command of the members of the association for information relative to patents upon machines or devices connected with electric lighting.

The need for the creation of such a bureau is very great, and is felt by many of you, and I am sure, when carefully consi'ered, will be fully appreciated by all.

The whole field of electric lighting apparatus, from the dynamo to the lamp globes, is covered on every square inch with patents of greater or less strength and breadth. You will not be surprised when I tell you that there are at this time in force in this country, on generators and lamps (arc and incandescent) alone, something more than 1,750 patents, not to mention those on collateral details in addition, not included under these heads; and they are increasing with every week's issue.

It is therefore easy to appreciate how impossible it is for any one to enter the electric lighting business without running against some of these claims, and if no accurate information with reference to their real scope is in the possession of the person who comes upon them, or is attacked by them, how is it possible for any of you to determine what is to be done when such a contingency arises. Of course it can be said, "Go to the best lawyer you can find, and get him to examine the matter and give you an opinion." Yes, that is an excellent method, provided you have got from $500 to $5,000 to spend in that way. Then, too, almost all of you are licensees under one or more of these patents, which are owned by individuals or corporations that are living off of your earnings; and I suppose I would not be rash in asserting that not one out of ten of you have any idea whether the companies to which you are paying royalties have any legal right to demand them or not. You went into the enterprise at first upon their assurance that everything was all right, and you have gone on without questioning the position of the parent companies, and will continue to do so, unless some method is adopted by which you can procure at a nominal cost reliable information, upon which you can act.

Your position is not a new one. Some twenty years ago the railroads of this country found themselves in very much the same position which you occupy to-day. They were creating a business, and as the amount of capital invested became greater and greater, and the dependence of that capital upon machinery of particular kinds became more apparent, these companies were made the victims of the cupidity and schemes of designing speculators, who would buy up a lot of worthless patents, and then make a claim upon them for large royalties, claiming that certain appliances of vital importance to the railroad companies were covered by one or more of their patents, and the companies were presented with the alternative, "Either settle or fight;" and it was a question as to which would be the more expensive.

This system of blackmail became so burdensome that the companies were forced into a combination for mutual protection. They accordingly formed an association which is called the Railroad Association, the purpose of which was to employ counsel and economize the conduct of these controversies. To this association each member contributed in proportion to its strength, and from 1866 to the present time the saving to the railroad companies has been as twenty to one, or for every dollar they paid this association they have saved twenty by belonging to it.

The members of the association have the privilege of referring any question involving a patent to its counsel of the association, by whom it is investigated and reported upon with promptness, and with no other cost than their annual subscription. If the counsel advises that the claimant has a just claim, he arranges with him the best terms he can for settlement, and calls upon the company to pay up. If he determines that the claim is invalid, he so reports it, and then if suit be brought the association undertakes the defense upon itself and bears all the cost.

A similar plan would supply a need to the members of this association. It might not be desirable at this time that the association undertake the defense of cases brought against the members and believed to be bad, but it is very desirable that a source be provided from which any of the members may be able to get an intelligent opinion upon any patent relative to electric lighting apparatus that they may desire, and that at the small cost of membership to this association, either for the purpose of resisting demands upon them or for intelligently examining enterprises for investment

Let any member of this association who is a purchaser from the manufacturers of electrical apparatus calculate the cost of construction of the apparatus he is buying, and compare it with the price he is paying, and determine what percentage of profit is made upon these goods, and then let him consider that this large profit and high price—in the average quite 100 per cent, and in many cases 500 per cent.—is consequent upon the possession by the manufacturers of patents of very questionable validity, some of which are certainly void, and which, if declared so, would reduce the cost of these goods, and hence the net profits of the sub companies, in proportion. I do not think I am stating the case too strongly when I say that, if these patents were examined critically and placed upon a true and proper basis, the average cost of apparatus could be reduced at least 20 per cent. If such were the case, and the saving thus made by all the members of this association were added together, they would certainly amount to considerably more than a hundred thousand dollars. It requires but a comparison of this sum with the cost of maintaining this department, which would probably be some four or five thousand dollars per annum, to illustrate its economy.

2d. The plan upon which such a department should be conducted would be to select a suitable person as general counsel for the association, put into his office copies of all the American and foreign patents pertaining to electric lighting, and such other library as would be desirable, or, if he were located in Washington, he could be near enough to the Patent Office to use the records there with facility.

A committee should be appointed, of which he and the custodian of the Bureau of Information should be members, with such other persons as might be selected, whose duty it would be to hear and consider the reports of the counsel upon cases examined for members, and to determine whether his reports were correct. These reports, when acted upon by the committee, should be filed in such manner as to be at hand whenever needed for reference.

Your committee cannot too strongly urge the establishment of such a bureau as of inestimable advantage to the members.

Respectfully submitted.

ARTHUR STEWART,
Chairman Legal Committee
N. E. L. Association.

On the Transmission of Power to the Dynamo.

BY JAS. A. PENTZ, PHILADELPHIA.

To make electric lighting commercially successful three things are necessary:

Steam must be generated as cheaply as possible.

It must be transmitted economically, and

The apparatus comprising the entire plant for the production of the electric current, and its delivery to the circuit, must be of the best.

To the consideration of the second proposition this paper is addressed.

First of all, the following statement will be conceded by every one present: We cannot get power through complicated machinery, economically. Nor yet is the simplest motor the best one to use, when its running expenses are considered.

Plainly stated, if the steam could blow directly upon a wheel without piston or valve gear, as the wind does upon a windmill, which we may say is secured upon the dynamo shaft, the problem would be solved, provided the power could be employed in this way as cheaply and as conveniently as is usually done through a more complicated piece of machinery, which we call a steam engine. But inasmuch as this system has been tried in many ways, and found not to answer, we must look to other methods nearest approaching the cheaper way as concerning the cost of transmission, regarding, less however, the first cost of the motor.

Without going into a discussion on the merits of the different kinds of engines, which would be without end, the statement is perfectly safe to make that the fixed cylinder engine driving onto a revolving crank-pin is, all things considered, the best. This conclusion has been arrived at after fortunes have been spent upon the steam wheel, the rotary engine, and the oscillating cylinder engine, in futile attempts at making any one of them a successful motor from a commercial point of view, whatever they may have been mechanically.

There are so many things to seek for and inquire about in the subject matter before us of such vital importance that we cannot afford to review it hurriedly. It has not yet received full attention, and as this very important branch of mechanical engineering is not considered as it deserves to be, it may be well to take in some of the points bearing directly upon it, and calmly, and without bias, look into those factors that have a direct bearing upon its solution.

In treating this question it is well understood that prejudices will have to be combated and removed, for there are many who, without having looked thoroughly into the subject, are following too closely merely first-tried, unimproved methods, when better ones are to be had for the searching.

The first essential in the employment of power is to get it transferred to the dynamo by means of and through the least number of organs of transmission; and it is likewise important to do it mechaically, in the most direct manner.

This brings us face to face with the high-speed engine, and the one-belt method of power transmission from the engine pulley to the pulley of the dynamo as the simplest and the best.

Countershafts, as applied to electric lighting, are quite unnecessary. They require more space than is usually allotted to the driving plant; adding also to its first cost, and to the cost of keeping them in good working order. Any increase in shafting and pulleys must require additional attention, and, furthermore, additional power to drive them, thereby lessening the effective force of the engine.

A few tests of shafts are given herewith to reinforce the general statements just made.

In fifty-five (55) carefully made experiments on factory engines, developing under full load from 46 horse-power to 1,485 horse-power, showed the percentum of the extremes of resistance of engine and shafting to full load to be from 16.5 to 39.2 of the horse-power, and an average of 29 9 of horse power, while that of the engine alone averaged but seven per cent.

In another series of eight (8) tests of factory engines, the average proved to be 22 per cent.; and in another case, where the total horse-power employed was but 120, the resistance amounted to 33 per cent.

If, then, all these drawbacks are to be found in countershafting it may be dispensed with, and some good plan produced whereby electric light plants may be run economically.

No doubt plants run by low speed engines driving to a countershaft have given good results, but if we can do better without this useless auxiliary, had we not better do so?

It brings us not only to the discussion of the benefit to be derived by belting direct from the engine pulley to the dynamo pulley, but to the superiority of the high speed engine in connection with electric lighting.

In the employment of the high speed engine we gain these points:

1st. Economy of fuel and space occupied by the plant· 2d, economy in first cost of the plant; 3d, uniformity of speed and regulation; 4th, reduction of cost of repairs and maintenance.

Engines of this type must be of the best material and workmanship to insure good running and long life, and should be of ample width. There should not be the slightest deflexion or tremor in the bed under the most trying conditions, consequent upon the greatest variation in the load.

The revolving parts must be correctly balanced; the reciprocating parts light and strong; the bearings of proper materials and of ample size; the lubrication automatic, and the parts containing steam should be well clothed to prevent loss by radiation.

The steam in these engines is utilized in the cylinder to much better advantage than in the cylinders of engines running at low speed, and for obvious reasons.

It is a well-known fact that steam must be used as quickly as possible after it is generated, to avoid loss of efficiency by condensation and radiation of the heat, which is very rapid from the pipes and vessels containing it, as they are usually made and employed.

In the early use of steam in running engines, which were necessarily of low speed, steam jackets were found absolutely indispensable to the proper action of the engine, but later practice, with moderately speeded engines, has shown the warming of steam cylinders by jackets to be unnecessary.

The modern high speed engine uses the steam as quickly as possible after it is generated, reducing the time of its transmission to the engine to the least, by which the loss of heat is reduced to a minimum. The saving from this source alone is considerable, and as the steam cylinders of high speed engines are small in proportion to their power, the losses by reduction of cooling surfaces become smaller alone.

The economy of fuel as bearing directly upon the engine may be said to begin at this point, and is carried higher by the nearer approach to perfect regulations given by the engine.

The action of the governor of the high speed engine being quicker the steam is controlled more eagerly, and the speed of the engine more readily kept uniform.

It has been stated that the friction of an engine is increased when it is run at high speed, but recent experiments made at Cornell University, under direction of Prof. Thurston, and with a modern high speed engine, clearly demonstrated that such is not the case.

M. Morin's third law of friction reads: "That friction is independent of the velocity of motion" (p. 261, "Fundamental Ideas of Mechanics," D. Appleton & Co, N. Y.) This was announced by him and deduced from his exhaustive experiments made during the year 1834, and this law has been generally accepted by engineers since.

Attention may also be called to a test of a steam-engine at the American Institute two years ago.

In this test the engine was found to work through a large range of power, with little or absolutely no increase of friction There were no extraneous conditions that would modify results, and in the machine itself nothing but ample, well-fitted bearing surfaces. According to the generally accepted laws, friction ought to have increased with the load, but numerous careful experiments showed that it did not.

We now come to the most efficient, economical and decidedly the most satisfactory method of dealing with this question, that of belting direct from the driving pulley of the engines to the dynamo pulley. By this means the connection between the engine and the dynamo is single and direct.

With the best of dynamos, when driven by engines well adapted to the purpose, good belting is necessary to the securing of uniform results.

A case occurred at the Electrical Exhibition held in Philadelphia two years ago, which will illustrate this point. While the

tests were being conducted a tremor of the lights was observed, which was at once attributed to the engine driving the dynamo.

The fluctuations of the lights were observed to occur in times whose periods were measured by several revolutions of the engine.

The engine was at once thoroughly examined, even to the removal of the governor, which was overhauled and retested by the regular appliances at shop, but the search revealed nothing that would explain the cause of the disturbance, for the governor was found to be without defect.

The whole trouble was discovered afterwards to be caused by the belt lacing, which, in passing over the dynamo pulley, jerked the belt, and effected the results in lighting.

Belts for driving dynamos should, therefore, be made of the best material, of uniform thickness and density and practically straight in their run through the air and over the pulleys. They should be soft and pliable and kept so by proper application of the usual and obtainable unguents prepared for this purpose.

In the use of belts for driving dynamos, they should be made endless, that is, without laced or other unevenly made joints, and when made of double thickness, care should be taken to select such makes as will give an even and full contact surface of the leather constantly to the faces of the pulleys.

Large headed copper rivets should be avoided, because they reduce the contact surface of the belt, and coarse stitching and knots should not be used, because they destroy the smoothness of the belt's surfaces. Both diminish the adherents of the belt upon the pulleys.

The best form of engine to drive one or two dynamos, is that in which the steam acts upon a center crank, with ample shaft bearings upon each side, and with the pulleys on over-hanging shaft ends.

From each of these pulleys a belt is run to the dynamo pulley. Either belt may be removed by hand when one dynamo is only required to be run.

Where the number of dynamos required is more than two, the simplest method of bolting direct to the dynamos, is to use two engines, made right and left, set parallel with each other, and with the main shaft connected to, and running in line with both engine shafts, supported by proper intermediate bearings from the floor. This practically makes it the same as if the engine shafts were extended, and is of the same diameter. This being, practically, inflexible, and running at the same speed as the engine, makes it an easy matter to belt from the pulleys which it supports, to the pulleys of the dynamos, thereby delivering the power, with least loss, to the electric machines direct.

Each pulley on this shaft can be made independent running by a friction clutch, so that, if by any reason a certain dynamo is not required to be run, it can be stopped, and without interfering with the working of the others.

At either end of the engine shaft, and directly next to the engines, a cut-off friction coupling should be provided. This is to insure against stoppage of the whole plant, if accident should occur to either engine. By this means, one engine can continue to do the work.

Without extending these remarks too far, it is proper to add that numerous experiences have proven that better engineering expedients lie within the limits of the larger diameters for shafting, which secures rigidity, from the known fact that the inflexibility of the smaller shafts usually employed on the score of economy creates more friction, by being drawn "out of line" by the pull of the belts in action upon the dynamo.

Again, with regard to the question of perfect regulations of engines: A single engine, running at a slow speed, will not produce relatively as equal a motion as a single engine running at a high speed. To effect regular motion with slow-running engines, it is necessary to employ them in pairs, with their cranks set at right angles. Even then the result obtained will be no more satisfactory than that effected by a high-speed single engine.

There is a normal speed for every build of engine; it is very certain that an engine made for low speed will not run at a high speed without injury to itself, and possible destruction, but we have abundant testimony proving high speed in engine work to be a pronounced success.

It involves, of course, many of the less known elements of design and construction and ever and always the best of materials, workmanship and attendance, all of which, however, are within the reach of modern shop practice, as they are of moderate price.

If proper care be taken in the selection of steam motors, after intelligent examination of such as are already in use; if particular attention be given also to the installation and management of the whole plant, and if no part or parcel thereof be accepted, believing it to be the cheapest in the end, because its first cost is least, then will the production of electricity for lighting and other purposes make great and permanent advances.

JAMES A. PENTZ.

Mr. Woodbury's Letter on the Formation of an Electric Mutual Insurance Co.

BOWDOIN BUILDING,
Boston, Mass., August 23, 1886.

F. A. GILBERT, ESQ.,

Dear Sir—The results of the canvass of the electric illuminating stations, in reply to communication of July 15, show that from 173 electric illuminating companies in the district selected for a beginning, insurance on property to the value of $1,084,179 has been offered by about 50 companies, and indefinite replies received from about $200,000 more. As some of the property included above is not desirable for mutual insurance by reason of the hazards imposed on the stations by poor construction of the surrounding buildings, or the station itself, it can be safely assumed that $1,000,000 represents the maximum amount of mutual insurance available, as far as shown by this canvass.

Now these returns do not warrant me in recommending the formation of an Electric Mutual Company at present.

As I said at the time when the plan was first presented, the formation of an Electric Mutual Insurance Company on a sound basis would require 150 policies of $10,000 each, and the surplus insurance desired above that amount by any station could be placed in other mutuals or the stock insurance companies.

A company must be prepared at any time to meet a total loss on a policy, and it would certainly be unwise to attempt the organization of such a company on a basis which could not but endanger the liability of an assessment at any time. Secondly, limiting the policies at amounts which would be so far within the valuation of the property would increase the liability of extinguishing the policy at slight fires, and therefore other insurance, conducted on a similar policy, would be necessary to keep down the average impairment of policies by small fires on large risks.

These matters, and the returns, show that the central stations at the present time are insufficient in number, value, and in some instances character, as fire risks, to warrant the formation of the proposed organization, although it is evident to any one who has given consideration to the rapid increase of investments in electric lighting that the day is not far distant when an electric mutual insurance company will be as much of a business necessity as the textile, the rubber and paper mutual companies.

And this brings me to the second proposition advanced to you several months ago, namely, that the active co-operation of the established factory mutual insurance companies would be desirable in any event to carry some of the insurance on larger stations, and bring the total insurance on such property up to an amount commensurate to the value of the risk, so that the policy would not be exhausted by a slight fire.

Some of these companies, organized at a later date, have not confined their attention to textile and paper mills, but have also written upon other industrial property when satisfactory and well protected. It was expected that these companies would take the surplus insurance on electric lighting stations beyond the amounts considered advisable to be written by the proposed electric mutual insurance company.

As the present state of affairs does not permit the consummation of the original plan, I made a statement of the facts in the case to the mutual companies named below, and they have agreed to write upon such electric lighting stations as may desire the insurance, subject to my inspection and approval of the risk.

These companies are managed in a conservative manner, and the following statements of their standing July 1, 1886, furnished me by their secretaries, show their financial strength:

	Insurance.	Total Assets.	Premiums.	Return Div.
Enterprise Mutual Fire Insur. Co...	$11,544,183	$675,972.86	$113,011.48	$75
Cotton and Woolen Mfs. Mut. Ins. Co.	11,181,387	643,989.23	107,421.68	75
American Mutual Fire Ins. Co.....	11,086,664	657,578.01	109,868.04	75
Mercantile Mut. Ins. Co.	4,000,144	209,690.04	35,039,22	(1) 50
Rubber Mfs. Mut. Ins. Co.	3,209,671	364,401.61	43,970.76	(2) 25
Total....	$51,022,054	$2,551,631.75	$409,311.18	

I. Profits for the year, 61 per cent.
II. Profits for the year, 96 per cent.

The work of organizing an insurance company at any time requires much time and expense, which will be avoided by this course, as suggested; and if at any future time, when the growth of electric lighting stations would warrant the formation of an electric mutual insurance company, managed solely by the electrical interests, it would be a very simple matter to cancel the policies and rewrite them in the new company.

After a careful consideration of the whole matter these companies will probably insure satisfactory electric lighting stations at the gross rate of one per cent., and if the return dividend is 75 per cent., it will reduce the cost of insurance to 25 cents on $100. These mutual companies do not ask for a single dollars' worth of insurance upon these stations, but in answer to the statements made to them have consented to the policy outlined above.

I have nothing to urge in the matter, but as it will be impossible for me to attend the Detroit meeting of the National Electric Association, I submit this statement, with the opinion that it is the best course for you to pursue under the circumstances. Yours very truly,

C. J. H. WOODBURY.

* * According to the *Comptes Rendus* M. de Lacaze-Duthiers uses in his Sorbonne laboratory and in his zoological stations at Roscoff and Banyuls an electric lamp constructed by Trouve which which would also be useful in much chemical, botanical and mineralogical work. It is composed of a cylindrical glass vessel, beneath which is a mirror of silvered glass. There is a silvered parabolic covering, in the center of which is suspended an incandescent lamp. The vessel is filled with sea-water containing corals, polyps, sea worms and other objects which can be examined by the aid of magnifying glasses, the whole mass being thoroughly illuminated as in the brilliant experiment of the illuminated fountain. The apparatus can be readily modified for the study of fermentation and for dissecting with great ease nervous filaments of the greatest delicacy, which are hardly visible in the broad light of day. The generator of electricity is Jamin's universal automatic battery, weighing less than 3 kg.

* * Thefts of money from garments hanging in the clothes room of a Meriden factory led the electrician of the establishment to try to catch the hitherto undetected thief. He connected a pocketbook in the pocket of a pair of trousers with wires that terminated at a gong in a distant room, and so arranged the wires that the gong would ring when the pocketbook was moved. The pocketbook was moved, the gong sounded, and the thief was caught.

The Great Earthquake.

The news from the Charleston earthquake shows that no equally calamitous earthquake has ever occurred in the United States, and the New York *Sun* says, "It would be difficult to find upon record a more widespread disturbance of the earth's crust in any part of the world. Coincidently with the shocks which either wrecked or rendered uninhabitable two-thirds of the houses of Charleston, the ground trembled and cities and villages were shaken over half the Union. It seems providential that not more, and perhaps less, than a hundred persons lost their lives under the falling walls of Charleston.

"In the unusual duration of the shocks, and their rapid recurrence—ten or a dozen distinct tremors having been felt within twenty-four hours—this convulsion recalls the terrible experience of the province of Granada in Spain a year ago last winter. To read of one of our own cities overthrown and deserted, and its surviving inhabitants encamped around it, afraid to return to their shattered and crumbling dwellings, is bringing the danger from earthquakes much closer home than most of us had, perhaps, dreamed of.

"That the center of the disturbance was located at or near Charleston is indicated not only by the greater force and destructiveness of the shocks there, but also by the fact that the slighter tremors of yesterday were only felt in that region. That the outburst of the Yellowstone geyser and the volcanic phenomena reported from Indiana were in some way connected with the great earthquake on the South Atlantic coast is not, perhaps, impossible, although it would be difficult to account for their connection upon the generally accepted theory of the cause of earthquakes. Many of the dreadful accompaniments of the historic earthquakes of Lisbon and Caracas appear to have attended the Charleston convulsion, such as the opening of the fissures in ground out of which sand and other material was spouted, and the presence of a strong sulphurous smell in the atmosphere. The story told in our dispatches of the scenes of terror and death amid the falling and burning buildings of the beautiful Carolinian city is a strange and appalling one.

"The powerful upward thrust of the shock was particularly noted in Washington, and this fact seems to indicate that the source of the disturbance was deep in the earth. The bursting of several mill dams more than a hundred miles from Charleston shows also the terrific power and wide extent of the principal shocks.

"A word as to the probable cause. We must remember that we are dwelling upon the surface of a little extinguished sun, which ages upon ages ago became covered with a rocky crust through the gradual loss of temperature, but which still retains in its interior a remnant of the pristine heat that is slowly leaking out. Every schoolboy understands that when a heated body cools it shrinks in size. The earth does the same, and, as the interior mass thus slowly contracts, the hardened crust settles upon it. But the crust cannot thus settle without breaking. Far back in geological time, when the cooling process was much more rapid than it is now, the settling of the crust broke and contorted it with tremendous power, and the edges and sides of the cracked strata of rock were thrust up into mountain chains. Now, when the cooling is very slow and the consequent contraction comparatively slight, mountains are no longer created by the stress upon the settling crust, but slow, almost imperceptible, changes of level in different parts of the earth's surface result from it. So slowly, in fact, does the interior of the earth contract at present that the settling of the crust is accomplished for the most part without the knowledge of its inhabitants. Yet it does contract, and the careful observations of earth tremors which have been conducted of late years show that, if a complete record of the motions of the earth's crust could be obtained, it would be shown to be slightly trembling in some part of its extent most of the time.

"There are certain regions where the

earth's crust yields to this internal strain more readily than elsewhere. These regions are usually in the neighborhood of ancient cracks or faults in the rocky shell of the planet. The Atlantic edge of our continent has never, in historic times at least, been the scene of great and disastrous earthquakes, and yet its geological structure is such that disturbances of this kind could hardly fail to visit it. The fact is that many earthquakes do occur in this country, but they are usually so slight that little or no notice is taken of them. In the Charleston earthquake it may be said that the portion of the rocky crust concerned in the disturbance, having presented an unusual resistance to the strain of internal contraction, finally yielded with a proportionately violent result. In that case, we may expect that after the present convulsion has completely subsided a long time will elapse before another severe earthquake occurs in the same region, and such is generally the history of disastrous earthquakes."

The New Brush Motor.

We present to our readers in this issue a cut of the new Brush motor.

As will be seen, it resembles the Brush dynamo in appearance.

In the employment of motors in a circuit in which the strength of current or the load is liable to variation means must be provided for automatically controlling the speed and making it practically uniform.

Mr. Brush has apparently solved the problem in quite a novel manner.

He provides a centrifugal governor, not unlike that used on the Buckeye engine, consisting of a metallic shell securely bolted to the armature shaft. To the inner periphery of the shell are pivoted, on opposite sides of its center, two governor arms, the inner and free ends of which are connected to the opposite arms by means of spiral springs.

On each of the arms are placed adjustable weights.

To the arms near their free ends are pivoted links, the opposite ends of which are connected to the commutators.

The commutators are set loosely on the armature shaft.

As the governor shell rotates with the armature shaft, carrying with it the parts described, the weights will at a certain speed be moved by centrifugal action toward the periphery of the shell, and through the medium of the connecting links impart a rotary adjustment to the commutator, varying its position on the armature shaft.

When the motor is at rest the spiral springs will retain the weights in close proximity to the shaft, and the commutator at the extreme limit of its rotary adjustment in one direction, and the brushes will bear on the maximum points of the commutator.

When current is switched into the motor, rotary motion is imparted to the armature and its shaft, the speed of which gradually increases until it has attained its predetermined or normal rate of speed, when the governor weights will begin to recede from each other, and rotate the commutator on the shaft carrying its maximum point away from the contact point of the brushes.

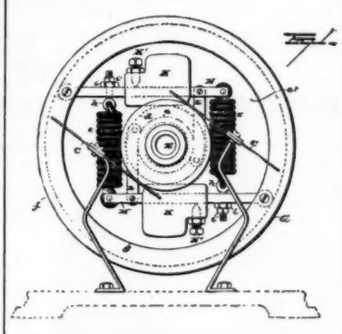
This action decreases the effect of the current until a point is reached where this effect is balanced by the load on the motor and the speed remains constant.

On the other hand, should the speed of the motor be retarded by a decrease of current or an increase of load, the governor weights will be drawn toward each other by the spiral springs, and thereby rotate the commutators in the opposite direction, the effect of which is to move the maximum points nearer to the brushes and thereby increase the speed.

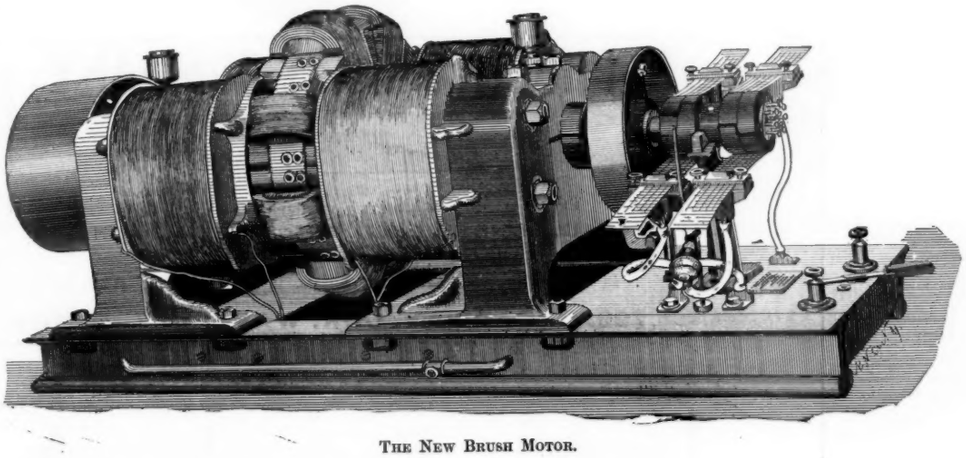
The direct connection of the governor with the commutator would seem to insure prompt adjustment of the latter without lost motion, and at a minimum expense of power.

By locating the parts of the governor in compact form within a rotary shell on the armature shaft, Mr. Brush insures a very compact form of machine for shipment, and one requiring but a small space for its operation, and further, such construction and arrangement of parts will offer but little resistance in the rapid rotation of the former.

We understand that these motors are now being manufactured by the Brush Electric Company at Cleveland.



THE BRUSH GOVERNOR FOR ELECTRO-MAGNETIC MOTORS.



THE NEW BRUSH MOTOR.

Electromotive Forces Developed by Cadmium and Iodine.

Mr. A. P. Laurie, in a paper before the Chemical Society on "The Electromotive Forces Developed During the Combination of Cadmium and Iodine in Presence of Water," says he has determined, by means of a Thomson electrometer, the electromotive forces of cells consisting of a cadmium and a platinum plate immersed in a solution of cadmium iodide, containing free iodine. In one set of experiments, the amount of cadmium iodide in solution was constant and the amount of iodine was varied; in another the amount of cadmium iodide varied, the solution being in each case saturated with iodine; in a third, a constant amount of iodine, but varying amounts of cadmium iodide, were used. The results of the experiments is to show that if cadmium and water containing cadmium iodide and free iodine are brought together, a considerable electromotive force is developed, which steadily falls. This depends on the facts (1) that as the free iodine is diminished the electromotive force falls gradually at first, but more rapildy the less iodine there is present; (2) that as the cadmium iodide solution increases in strength, the electromotive force falls very rapidly while very small quantities of the salt are present, but more and more slowly as the amount of salt present becomes considerable. In both cases, the change may be represented by a continuous curve. The actual values are given in the paper.

— The Jarvis Engineering Company, 61 Oliver street, Boston, have received the contract to put in a steam plant for the Continental Clothing House, Freeland Soomes & Co., Washington street, Boston. It will consist of two steel boilers set with the Jarvis patent boiler setting and using National rocking grates. Armington & Sims Company's engine to run cutting machinery and electric lights, National feed water heater, Korting injector, etc. The Continental Clothing House was the first store in Boston to install electric lights from their own power.

— The Troy electric light company is stringing a new line on River and Congress streets, and will soon have in operation 160 additional incandescent lights, 48 of which will be in the post-office. When the new line is in operation it will make 1,000 incandescent lights in use in the city. The entire contract with the city for 250 arc lights is filled, and the lights are now run every night. The circuit was completed August 4. The new 90 horse-power engine that was recently put in at the station on Liberty and River streets works satisfactorily, and one of the 40 horse-power engines will next week be replaced by a 60 horse-power engine.

Digest of U. S. Patents on Storage Batteries.

REFERENCES TO FOREIGN PATENTS OBTAINED THEREON.

(NINTH PAPER.)

1884.

301,351. July 1, 1884. Filed Nov. 3, 1883.
English patent, No. 1,122, March 1, 1883.
French patent, No. 157,338, Sept. 1883.
Belgic patent, No. 2,487, Sept. 3, 1883.
German patent, No. 26,583, Sept. 12, 1883.
Desmond G. Fitzgerald, Brixton, Surrey, England.

Relates to electrodes, consisting of a non-oxidizable insulating perforated receptacle or envelope, made preferably of "Prouts' glue," "Charakite" or "Farley's marine glue" and lined with a perforated leaden sheet—within which is placed a perforated plate of lead surrounded by a mass of precipitated spongy lead—as acetate of lead and by means of zinc or by electro deposition.

Disclaims deposited lead.

302,623. July 29, 1884. Filed Feb. 25, 1884.
Achilles De Khotinsky, Rotterdam, Nether land.

Describes a battery composed of a number of shallow vessels of wood, vulcanite glass, etc., one above the other, and each vessel divided by partition walls into portions or compartments.

The floor space of the compartments being covered by metallic or carbon plates similar in shape—each plate covering half the surface.

302,783. July 29, 1884. Filed Aug. 16, 1882.
English patent, No. 3,240, July 8, 1882.
French patent, No. 150,146, July 17, 1882.
German patent, No. 25,155, July 19, 1882.
Canadian patent, No. 15,414, Sept. 7, 1882.
Thomas S. Sarney, Camberwell.
John W. Alprovidge, Herne Hill, Surrey, England.

Electrodes are made by coating thin sheets of lead with an oxide doubling the sheets upon themselves and passing between rolls—the process being repeated a number of times until laminated plates of the desired thickness are obtained.

Claims process.

303,237. Aug. 5, 1884. Filed Jan. 3, 1883.
English patent, No. 4,460, Sept. 19, 1882.
Gregoire George Skrivanow, Paris, France.

The negative electrode consists of a plate or disk of agglomerated carbon, gas retort carbon or graphite, covered on both sides with chloride of silver.

This element is immersed in a solution of the hydrate of potassium or sodium.

In proximity thereto is the positive element, consisting of a plate of zinc, immersed in the same liquid.

303,891. Aug. 19, 1884. Filed Apr. 21, 1882.
W. A. Shaw, Brooklyn, N. Y.

Relates to a pipe line system, in which the pipes form the storage batteries and contain the electrolytic liquid.

304,265. Aug. 26, 1884. Filed Jan. 3, 1884.
Isham D. Fuller, Atlanta, Georgia.

Describes a battery jar, comprising a glass inner vessel and non-conducting outer case, with a space between the two, adapted to contain oil.

— A movement is being agitated by the produce dealers doing business west of Broadway, between Harrison and Liberty streets, New York, to get the Aldermen to pass a resolution authorizing the lighting of the lower part of the city with electric lights. "There are many good reasons why this should be done," said G. S. Palmer, a produce dealer, recently. "In the first place, it would be a great prevention of crime. As it is now, most of the streets are dimly lighted, and strangers coming across the Liberty street ferry, and not knowing that Cortland street is lighted, go up Liberty street, which is dark. It is the very place to be chosen by highway robbers and pickpockets, and if there was a better light in the street pedestrians would be comparatively safe at all hours of the night. This is by no means the only important point in favor of the electric lights. While the majority of the people in New York are asleep there is going on one of the largest branches of trade—the purchase of produce worth thousands of dollars. Farmers and truck growers come in from the country, and from midnight until after daylight their wagons fill the streets around Washington Market. Money changes hands under the dim light of a faintly flickering gas jet; often grievous mistakes occur, which with better light would never take place. Go through this section any morning about two o'clock, and you will find the seller and buyer trying to come to some agreement over the price of a wagon-load of garden truck. On account of the imperfect light the commission merchant cannot detect the bad parts of the load, and he frequently finds himself with decayed fruits or vegetables, while, on the other hand, he cannot see whether the vegetables are better in quality than others that he may buy, and, of course, he will not pay what they are actually worth. Hardly a night passes that the police in the Twenty-seventh Precinct do not have cases of petty pilfering by sneak thieves reported to them. It is an easy matter for a thief to carry off a basket of vegetables or eggs, and many times live poultry is taken from the crates that they come in. The electric light would also be of material assistance to the firemen in getting to fires. Because the streets are narrow there is little room left for the passage of engines and hook and ladder trucks.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING SEPT. 7, 1886.

348,542 Electric arc lamp; Lewis G. Bronson, Chicago, Ill.

348,572 Testing station for conduit systems; Jas F. Munsie, Chicago, Ill., assignor of five-twelfths to Horatio N. May, same place.

348,578 Multiple switchboard; Thomas J. Perrin, Brooklyn, N. Y., assignor to Charles P. Huntingdon, Greenville, Miss.

348,579 Multiple switchboard; Thomas J. Perrin, Brooklyn, N. Y., assignor to Charles P. Huntingdon, Greenville, Miss.

348,603 Electric railway car illumination; Edward J. Wessels, Roselle, N. J.

348,606 Electric air pump system; Albert B. Worth, Greenport, N. Y.

348,625 Manufacture of secondary batteries or accumulators; Stephen Farbaky and Stepfan Schenek, Schemnitz, Austria-Hungary.

348,636 Electro-magnetic car brake; Harvey S. Park, Henderson, Ky.

348,646 Safety strip for electric circuits; Edward Weston, Newark, N. J., assignor to the United States Electric Lighting Company, New York, N. Y.

348,647 Holder for incandescent lamps; Edward Weston, Newark, N. J., assignor to the United States Electric Lighting Company, New York, N. Y.

348,648 Ampere meter; Edward Weston, Newark, N. J., assignor to the United States Electric Lighting Company, New York, N. Y.

348,649 Electric lighting system; Edward Weston, Newark, N. J., assignor to the United States Electric Lighting Company, New York, N. Y.

348,707 Automatic fire alarm system; Alden D. Wheeler, Boston, Mass., assignor to the American Automatic Fire Alarm Association, Portland, Me.

348,708 Electric connection for chandaliers; Jno. P. Willets, Jersey City, N.J., and Edwin K. Crolius, New York, N. Y.

348,792 Electric tramway system; Michael H. Smith, Halifax, County of York, England.

348,799 Electric arc light; Frank Thone, Fort Wayne, Ind.

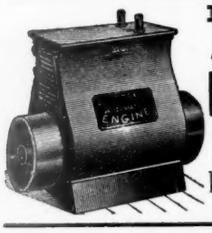
348,845 Hanger for electric lamps; Clark C. Haskins, Chicago, Ill.

BUSINESS NOTICE.

Wanted—Experienced workmen, accustomed to laying out and setting up incandescent plants; also first-class men experienced in installing arc plants; no communications will be noticed unless full particulars of experience, references, etc., are given. Address "Positive," office of ELECTRICAL REVIEW.

Parties Intending to purchase Electric Lighting Machinery, should consult
W. N. GRAY, Electrical Engineer,
CARLISLE BUILDING, CINCINNATI, O.

FOWLER & FOWLER,
PATENTS AND PATENT CAUSES.
NEW YORK, Temple Court, and WASHINGTON, Pacific Building,
ELECTRICAL INVENTIONS.
A. G. FOWLER, C.E., was Examiner in the U. S. Patent Office from 1880 to 1886, in the Interference and Electrical Divisions.


BURNHAM
SELF-OILING
Automatic Steam
Engine
Patented Feb. 23, 1886.
Catalogue sent free by
Burnham Engine Co.
YORK, PA.

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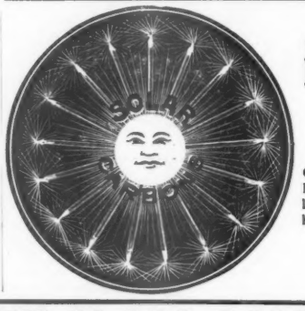

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The only Carbon made from Natural Gas Our works are thoroughly equipped with Modern Machinery, and we guarantee the longest life, greatest brilliancy without hissing.
GENERAL EASTERN OFFICE,
55 South Third Street,
Philadelphia, Pa.

Fig.259
PHOENIX GLASS COMPANY,
(Works, Water Cure, Beaver County, Penn.)
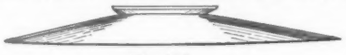
Fig.255
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SUN ELECTRIC COMPANY,

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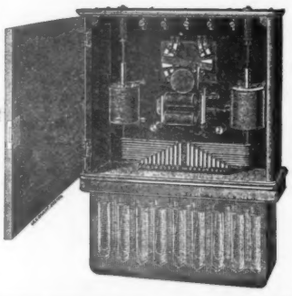
MANUFACTURERS OF THE



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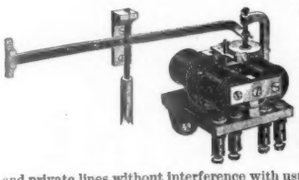

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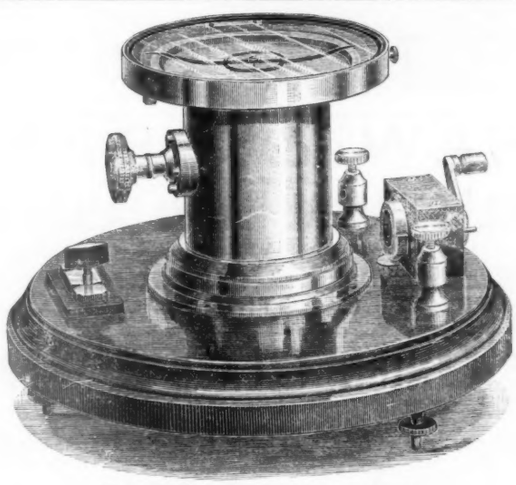

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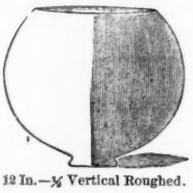

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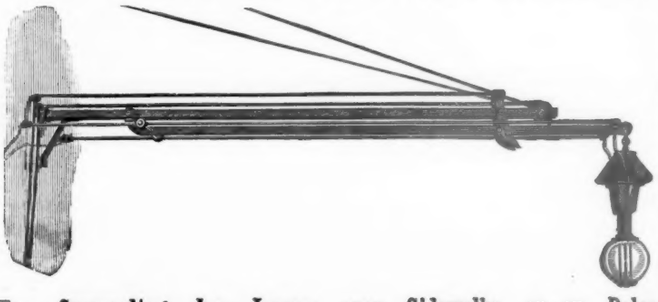

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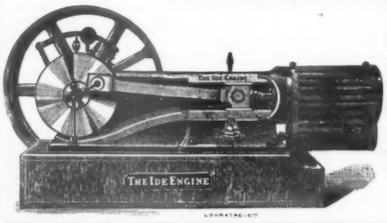

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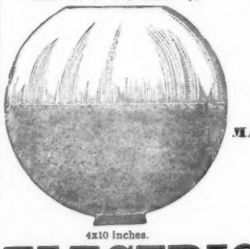

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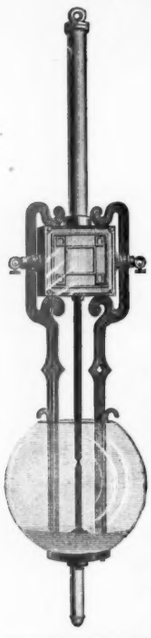

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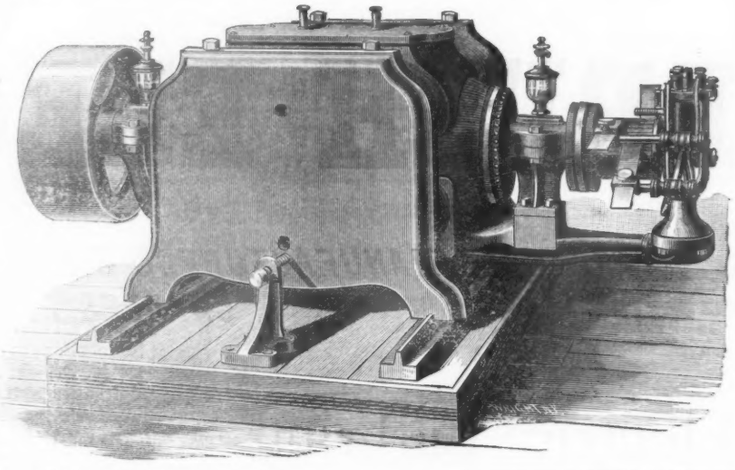

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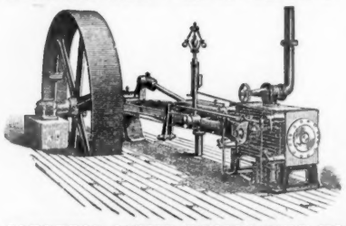

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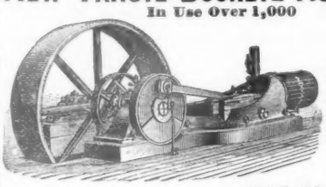

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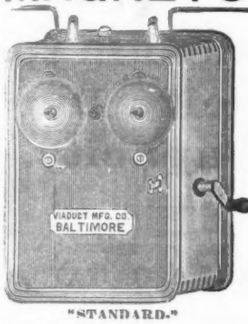

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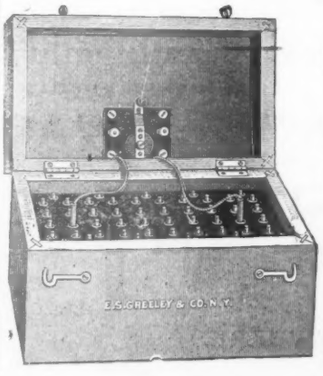

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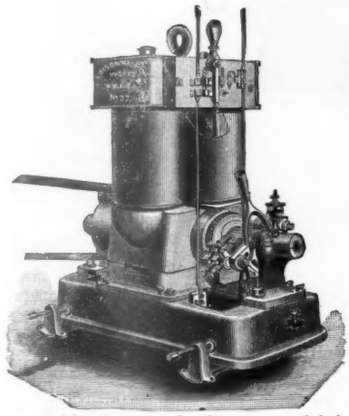

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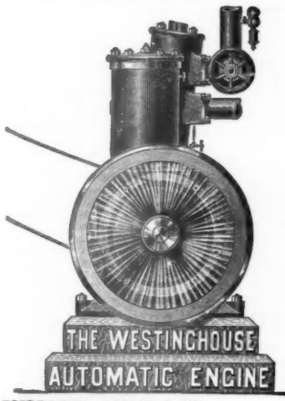
THE EDISON ELECTRIC LIGHT COMPANY

By EDWARD H. JOHNSON, Vice-President.



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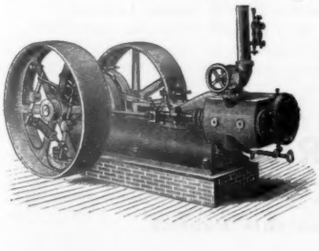

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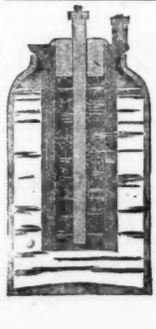

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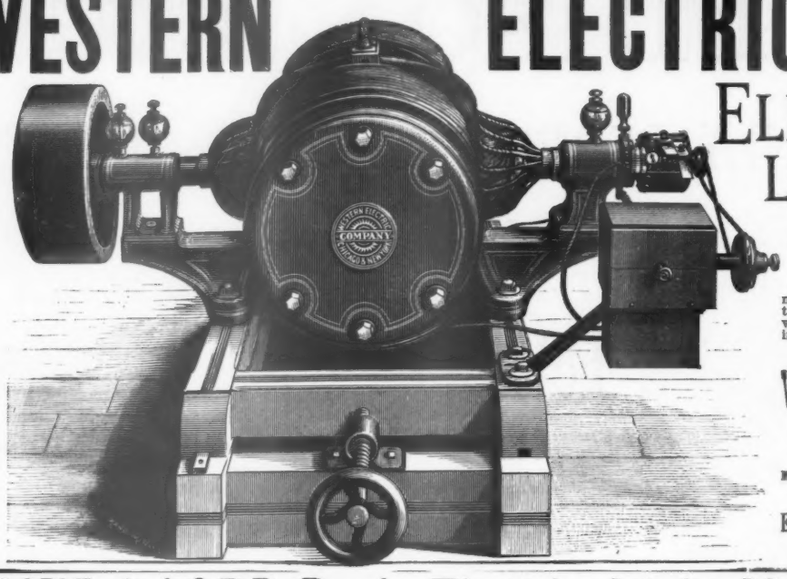

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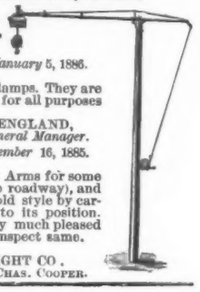

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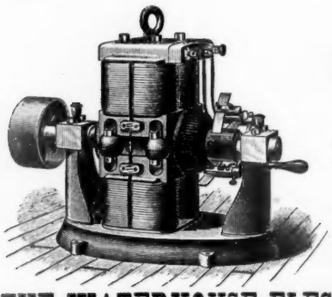

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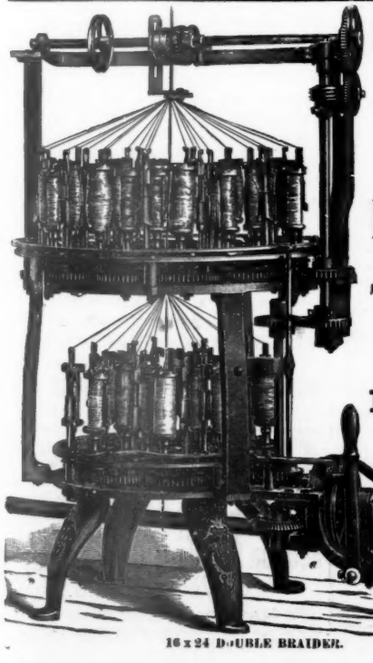

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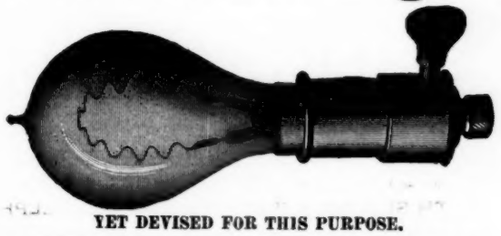

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